SAW

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(*Recognosce notum, ignotum inspice*)

TRANSACTIONS

Edited by

J. RAMSBOTTOM, B. BARNES and H. WORMALD

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VOLUME XXIII DECEMBER 1939 No. 4

FIFTEENTH PHYTOPATHOLOGICAL EXCURSION

Rothamsted, 1938

BY G. C. AINSWORTH.

THE Fifteenth Phytopathological Excursion was held at the Rothamsted Experimental Station, Harpenden, Herts, by kind permission of the Director, Sir E. John Russell, F.R.S., on Saturday, 2 July 1938.

About twenty-five members and friends assembled at the Experimental Station at 11.30 a.m. when a tour of the farm was undertaken. The classical experiments were inspected and the farm buildings visited under the guidance of Mr H. V. Garner, while Miss M. D. Glynne drew attention to various items of pathological and archaeological interest.

After lunch Dr Henderson Smith and Mr S. D. Garrett briefly outlined the investigations in progress in the Department of Plant Pathology which was then visited. Special attention was paid to the work on cereal root rots by Mr Garrett and his collaborators, Miss Glynne's study of the fungus flora of normal wheat roots, and the demonstrations of the virus work, including a series of crystalline virus preparations, arranged by Dr F. M. L. Sheffield, Mrs Watson and Mr F. C. Bawden.

(*Accepted for publication 7 August* 1939)

THE AVIEMORE FORAY

5–10 September 1938

By C. G. C. CHESTERS

The forty-second Autumn Foray and Annual General Meeting took place at Aviemore during the week 5–10 September 1938. Several members of the Scottish Cryptogamic Society were present. Through the good offices of Mr John Russell, the Comrades' Memorial Hall was made available for display of specimens and for meetings during the foray.

Monday was spent by those who arrived over the week-end in exploring the woods close to Aviemore, and during the evening the Council held a meeting in rather primitive conditions of lighting. For the next two days Rothiemurchus Forest provided more than ample scope for collecting which was mainly confined to the region lying between Loch an Eilein and Aviemore.

As on the previous foray, in 1927, the species of *Hydnum* and *Boletus* delighted members not used to such a variety of species so abundantly present. *Cantharellus cibarius* was extremely common in certain areas of the forest and *Exobasidium Vaccinii* was plentiful both on *Vaccinium Myrtillus* and *V. Vitis-Idaea* round Loch an Eilein. *Cintractia Caricis* was rediscovered on *Carex* by the shores of the Loch. *Tilletia decipiens*, on *Agrostis*, is an addition to the list for 1927 but several of the species collected during that year do not find a place in the list for this year.

On Thursday the party travelled to Boat of Garten and walked to Abernethy Forest. The larger fungi were fewer in quantity and in number of species but several interesting microfungi were observed. *Chrysomyxa Empetri* was abundant along the fringes of the Forest. Those who penetrated as far as Loch Garten brought back *Physoderma Menyanthis* and *Protomyces macrosporus*. Near the Coylumbridge road *Myrica Gale* was heavily infected with *Ovularia destructiva*. Much energy was expended by some members in unearthing *Elaphomyces granulatus* with its parasitic *Cordyceps*.

On the following day most of the party went to Carr Bridge and explored the region between there and Aviemore while others started from Aviemore to examine the woods along the road running north. Mr Rea collected some good specimens of *Pholiota flammans* but the larger fungi were not particularly abundant on this excursion. The list for this day mainly includes microfungi, the majority of the additions being species occurring on grasses.

Miss Sampson delivered her Presidential Address on "The Life Cycles of Smut Fungi" at 8.45 p.m. on the Tuesday evening. The Annual General Meeting was held on the following evening. The Secretary read the report by Dr S. Dickinson, on the British Association Meeting at Cambridge. The revision of Rule 6 was then discussed and the Meeting decided that in future the rule should read as follows: "The Government of the Society shall be vested in a Council, which shall consist of the President and other Officers for the time being, together with nine other Members who shall be elected annually at the General Meeting, three of whom shall be elected to replace three retiring members, who shall not be eligible for immediate re-election. The Members to retire shall be those who have been longest in office, or, in case of equality, shall be determined by ballot. Ex-Presidents who have served their year of office prior to 31 December 1936 are ex-officio members of the Council. From 1937 the retiring President shall become a Vice-President for a period of two years." Thereafter Officers for 1939 were elected. Mr E. W. Mason was elected President. Miss D. M. Cayley was elected as a Vice-President and Miss K. Sampson and Mr Cartwright automatically become Vice-Presidents under the terms of Rule 6, the last serving for his second year in that office. The other Officers were re-elected. The members of Council elected in 1936 agreed to serve for a further year and three new members were elected as follows: Dr M. Brett, Miss M. W. Rea and Miss F. L. Stephens. Dr Chesters was chosen to represent the Society at the meeting of the British Association to be held in Dundee in 1939. It was decided that the Autumn Foray in 1939 should be held at Chipping Campden.

At the close of the meeting very cordial votes of thanks were passed to all the landowners whose estates had been visited during the foray.

RECEIPTS AND PAYMENTS FOR THE YEAR ENDING 30 JUNE 1938

1937	£	s.	d.
1 July—Balance brought forward	655	0	11
1938			
30 June—Subscriptions to date	345	10	7
Gifts to Printing Fund	4	6	8
Sale of *Transactions*:			
Current vols.	101	16	3
Back vols.	38	19	2
Sale of Reprints	12	12	0
Profit from sale of C. Rea's *British Basidiomycetae*	6	13	2
Deposit Interest	3	5	3
War Loan Interest	17	10	0
	£1185	14	0

1938	£	s.	d.
30 June—Cambridge University Press, Cost of 450 vol. XXI *Transactions* and Reprints ...	524	1	10
Postage, Stationery, etc.	9	17	10
Sundry Printing	6	18	6
Fees of Meetings	4	4	0
Cheesman Fund Allowance	3	0	0
Balance in hand and on deposit	637	11	10
	£1185	14	0

CAPITAL ACCOUNT—Robinson Bequest, £50; Cheesman Fund, £150; Printing Fund, £300 } invested in 3½% War Loan

A. A. PEARSON, *Hon. Treasurer*

Examined and found correct, F. G. GOULD

The following have kindly sent gifts to the Printing Fund:

	£	s.	d.
Dr F. J. F. Barrington		5	0
Dame Helen Gwynne Vaughan ...		10	0
Mr G. C. Hughes		5	0
Miss G. Lister	1	0	0
Mrs A. Montague		5	0
	£2	5	0

	£	s.	d.
Brought forward ...	2	5	0
Mr J. H. Miller		6	8
Dr A. Morgan		10	0
Dr G. H. Pethybridge		10	0
Rev. Prof. M. C. Potter		10	0
Mr E. W. Swanton		5	0
	£4	6	8

The list of species found during the foray is compiled from lists and records supplied by all the members present and the Secretary is particularly indebted to Mr Rea, Dr Ramsbottom, Mr Pearson, Miss Wakefield, Miss Stephens, Mr Cooke, Dr Smith, Miss Sampson and Dr Ainsworth for their assistance.

List of species gathered during the Foray

A. = Abernethy Forest; *Av.* = Aviemore and immediate vicinity; *C.* = Carr Bridge locality; *G.* = Boat of Garten; *M.* = Loch Morlich; *R.* = Rothiemurchus.

HYMENOMYCETES

Amanita mappa (Batsch) Fr., *Av.*, *R.*, var. alba (Gillet) Rea, *Av.*, muscaria (Linn.) Fr., *A.*, *Av.*, *C.*, *R.*, phalloides (Vaill.) Fr., *R.*, var. verna (Bull.) Fr., *R.*, porphyria (A. & S.) Fr., *A.*, *Av.*, *R.*, rubescens (Pers.) Fr., *A.*, *Av.*, *C.*, *R.*, spissa Fr., *Av.*

Amanitopsis fulva (Schaeff.) W. G. Sm., *Av.*, *R.*, vaginata (Bull.) Roze, *A.*, *Av.*, *R.*

Androsaceus androsaceus (Linn.) Pat., *R.*, rotula (Scop.) Pat., *A.*, *R.*

Anellaria separata (Linn.) Karst., *M.*

Armillaria mellea (Vahl) Fr., *A.*, *R.*, robusta (A. & S.) Fr., *A.*

Asterosporina asterospora (Quél.) Rea, *R.*, lanuginosa (Bull.) Schroet., *R.*, napipes Lange, *R.*, scabella (Fr.) Schroet., *R.*

Bolbitius vitellinus (Pers.) Fr., *R.*

Boletus badius Fr., *A.*, *Av.*, *R.*, bovinus (Linn.) Fr., *A.*, *C.*, *R.*, calopus Fr., *R.*, chrysenteron (Bull.) Fr., *Av.*, *R.*, duriusculus Schultz, *Av.*, *R.*, edulis (Bull.) Fr., *A.*, *Av.*, *C.*, *R.*, elegans (Schum.) Fr., *A.*, *Av.*, *C.*, *R.*, erythropus (Pers.) Quél., *A.*, *Av.*, *R.*, flavidus Fr., *M.*, luteus (Linn.) Fr., *A.*, *Av.*, *R.*, pinicola (Vitt.) Rea, *A.*, *R.*, piperatus (Bull.) Fr., *A.*, *Av.*, *R.*, reticulatus (Schaeff.) Boud., *A.*, scaber (Bull.) Fr., *R.*, versipellis Fr., *A.*, *Av.*, *C.*, *R.*, viscidus (Linn.) Fr., *R.*

Calocera viscosa (Pers.) Fr., *A.*, *Av.*, *C.*, *R.*

Cantharellus cibarius Fr., *A.*, *Av.*, *C.*, *R.*, tubaeformis Fr., *R.*

Clavaria cinerea (Bull.) Fr., *R.*, cristata (Holmsk.) Fr., *R.*, dissipabilis Britz., *R.*, fusiformis (Sow.) Fr., *R.*, stricta (Pers.) Fr., *R.*, vermicularis Fr., *R.*

Clitocybe aurantiaca (Wulf.) Fr., *A.*, *C.*, *R.*, candicans (Pers.) Fr., *R.*, cerussata Fr., *R.*, clavipes (Pers.) Fr., *A.*, *R.*, fragrans (Sow.) Fr., *R.*, incana Quél., *A.*, infundibuliformis (Schaeff.) Fr., *Av.*, *R.*, odora (Bull.) Fr., *R.*, rivulosa (Pers.) Fr., *A.*

Clitopilus prunulus (Scop.) Fr., *A.*, *Av.*, *C.*, *R.*

Collybia acervata Fr., *A.*, cirrhata (Schum.) Fr., *A.*, *C.*, *R.*, distorta Fr., *A.*, *R.*, lancipes Fr., *A.*, maculata (A. & S.) Fr., *A.*, *Av.*, *R.*, mephitica Fr., *R.*, murina (Batsch) Fr., *R.*, radicata (Relh.) Berk., *R.*, semitalis Fr., *A.*, tuberosa (Bull.) Fr., *A.*, *R.*

Coprinus atramentarius (Bull.) Fr., *R.*, micaceus (Bull.) Fr., *A.*, plicatilis (Curt.) Fr., *Av.*, *R.*, sterquilinus Fr., *C.*

Corticium comedens (Nees) Fr., *R.*

Cortinarius (*Dermocybe*) anomalus Fr., *A.*, *R.*, anthracinus Fr., *R.*, azureus Fr., *R.*, caninus Fr., *A.*, *Av.*, *R.*, cinnabarinus Fr., *A.*, *R.*, cinnamomeus (Linn.) Fr., *A.*, *Av.*, *C.*, *R.*, var. croceus (Schaeff.) Fr., *R.*, lepidopus Cooke, *A.*, *Av.*, *R.*, phoeniceus (Bull.) Maire, *R.*, raphanoides (Pers.) Fr., *A.*, *R.*, semisanguineus (Brig.) Maire, *A.*, *Av.*, *C.*, *R.*, tabularis (Bull.) Fr., *R.*, (*Hydrocybe*) castaneus (Bull.) Fr., *A.*, *Av.*, *C.*, *R.*, decipiens (Pers.) Fr., *A.*, *C.*, erythrinus Fr., *A.*, leucopus (Bull.) Fr., *Av.*, obtusus Fr., *A.*, scandens Fr., *A.*, subferrugineus (Batsch) Fr., *R.*, (*Inoloma*) argutus Fr., *R.*, bolaris (Pers.) Fr., *A.*, *R.*, cyanites Fr., *R.*, muricinus Fr., *A.*, pholideus Fr., *Av.*, *R.*, tophaceus Fr., *R.*, traganus

var. finitimus Weinm., *A.*, *R.*, violaceus (Linn.) Fr., *R.*, (*Myxacium*) delibutus Fr., *R.*, elatior Fr., *A.*, *C.*, *R.*, mucifluus Fr., *A.*, *R.*, mucosus (Bull.) Fr., *A.*, vibratilis Fr., *A.*, (*Phlegmacium*) caerulescens Fr., *R.*, caesiocyanus Britz., *A.*, *C.*, croceo-caeruleus (Pers.) Fr., *R.*, cyanopus (Secr.) Fr., *R.*, dibaphus Fr., *R.*, multiformis Fr., *Av.*, *R.*, scaurus Fr., *R.*, turmalis Fr., *R.*, (*Telamonia*) armillatus Fr., *R.*, bivelus Fr., *A.*, brunneus (Pers.) Fr., *A.*, *C.*, *R.*, gentilis Fr., *A.*, hemitrichus Fr., *Av.*, *R.*, hinnuleus (Sow.) Fr., *A.*, *C.*, impennis Fr., *Av.*, paleaceus (Weinm.) Fr., *M.*, rigidus (Scop.) Fr., *A.*, torvus Fr., *Av.*, *R.*

Crepidotus mollis (Schaeff.) Fr., *R.*

Dacryomyces deliquescens (Bull.) Duby, *A.*, *Av.*, *C.*, *R.*

Daedalea biennis (Bull.) Quél., *R.*, quercina (Linn.) Fr., *R.*

Entoloma clypeatum (Linn.) Fr., *R.*, costatum Fr., *C.*, nidorosum Fr., *A.*, *R.*, porphyrophaeum Fr., *C.*, *R.*, prunuloides Fr., *R.*, rhodopolium Fr., *R.*, sericeum (Bull.) Fr., *A.*, *C.*, *R.*, sinnatum Fr., *Av.*

Exidia saccharina Fr., *R.*

Exobasidium Vaccinii (Fuck.) Wor., *A.*, *Av.*, *C.*, *R.*

Flammula astragalina Fr., *A.*, *R.*, carbonaria Fr., *A.*, *R.*, hybrida Fr., *R.*, sapinea Fr., *A.*, *R.*

Fomes annosus Fr., *A.*, *R.*, ignarius (Linn.) Fr., *R.*, var. nigricans (Fr.) Lloyd, *Av.*, pomaceus (Pers.) Big. & Guill., *R.*

Galera hypnorum (Schrank) Fr., *A.*, *C.*, *R.*, mycenopsis Fr., *A.*, *R.*, tenera (Schaeff.) Fr., *A.*, *R.*

Ganoderma applanatum (Pers.) Pat., *R.*

Gomphidius gracilis B. & Br., *A.*, *R.*, glutinosus (Schaeff.) Fr., *A.*, *R.*, maculatus (Scop.) Fr., *A.*, *R.*, roseus (Fr.) Quél., *A.*, *C.*, *R.*, viscidus (Linn.) Fr., *A.*, *R.*

Hebeloma crustuliniforme (Bull.) Fr., *Av.*, *C.*, *R.*, versipelle Fr., *R.*

Hydnum aurantiacum (A. & S.) Fr., *R.*, auriscalpium (Linn.) Fr., *A.*, *R.*, compactum (Pers.) Fr., *A.*, *R.*, ferrugineum Fr., *A.*, *C.*, *R.*, fragile Fr., *R.*, imbricatum (Linn.) Fr., *A.*, *R.*, melaleucum Fr., *A.*, *R.*, repandum (Linn.) Fr., *A.*, *R.*, var. rufescens (Pers.) Fr., *R.*

Hygrophorus chlorophanus Fr., *C.*, *R.*, coccineus (Schaeff.) Fr., *R.*, conicus (Scop.) Fr., *A.*, *R.*, eburneus (Bull.) Fr., *R.*, laetus (Pers.) Fr., *R.*, micaceus B. & Br., *R.*, miniatus Fr., *R.*, pratensis (Pers.) Fr., *A.*, *R.*, psittacinus (Schaeff.) Fr., *R.*, Reai Maire, *R.*, subradiatus (Schum.) Fr., *R.*

Hypholoma fasciculare (Huds.) Fr., *R.*, hydrophilum (Bull.) Fr., *R.*, lacrymabundum Fr., non Quél., *C.*, sublateritium (Schaeff.) Fr., *R.*

Inocybe Cookei Bres., *R.*, fastigiata (Schaeff.) Fr., *R.*, flocculosa Berk., *R.*, geophylla (Sow.) Fr., *A.*, *R.*, Godeyi Gillet, *R.*, lacera Fr., *R.*, sambucina Fr., *R.*

Laccaria laccata (Scop.) B. & Br., *A.*, *Av.*, *R.*, var. amethystina (Vaill.) B. & Br., *A.*, *R.*

Lactarius blennius Fr., *R.*, camphoratus (Bull.) Fr., *R.*, deliciosus (Linn.) Fr., *C.*, *R.*, glyciosmus Fr., *R.*, helvus Fr., *M.*, mitissimus Fr., *R.*, pallidus (Pers.) Fr., *A.*, *C.*, *R.*, piperatus (Scop.) Fr., *R.*, pubescens Fr., *C.*, quietus Fr., *R.*, rufus (Scop.) Fr., *A.*, *Av.*, *R.*, spinulosus Quél., *A.*, subdulcis (Pers.) Fr., *A.*, *R.*, vellereus Fr., *R.*, vietus Fr., *A.*, *Av.*, *R.*

Lentinus cochleatus (Pers.) Fr., *R.*

Lepiota amianthina (Scop.) Fr., *A.*, *R.*, cinnabarina (A. & S.) Fr., *A.*, *R.*, cristata (A. & S.) Fr., *R.*, granulosa (Batsch) Fr., *A.*, procera (Scop.) Fr., *R.*

Leptonia chalybea (Pers.) Fr., *R.*, formosa Fr., *A.*, *R.*, incana Fr., *R.*, lampropus Fr., *A.*, *C.*, *R.*, var. cyanulus (Lasch) Fr., *R.*, sericella (Fr.) Quél., *A.*, *C.*, *R.*, serrulata (Pers.) Fr., *A.*, *C.*, *R.*

Marasmius dryophilus (Bull.) Karst., *A.*, *C.*, *R.*, foetidus (Sow.) Fr., *R.*, hariolorum (DC.) Quél., *R.*, oreades (Bolt.) Fr., *R.*, peronatus (Bolt.) Fr., *A.*, *C.*, *R.*

Merulius tremellosus (Schrad.) Fr., *M.*

Mycena Adonis (Bull.) Fr., *R.*, alcalina Fr., *A.*, *R.*, ammoniaca Fr., *A.*, *Av.*, *C.*, *R.*, atromarginata Fr., *A.*, *R.*, avenacea (Fr.) Schroet., *Av.*, *R.*, corticola (Schum.) Fr., *R.*, epipterygia (Scop.) Fr., *A.*, *R.*, flavo-alba Fr., *A.*, *R.*, galericulata

(Scop.) Fr., *A.*, *R.*, galopus (Pers.) Fr., *C.*, *R.*, var. nigra Fl. Dan., *R.*, metata Fr., *A.*, pelliculosa Fr., *C.*, polygramma (Bull.) Fr., *A.*, *R.*, pura (Pers.) Fr., *A.*, *C.*, *R.*, rorida Fr., *R.*, rosella Fr., *A.*, *R.*, sanguinolenta (A. & S.) Fr., *A.*, *R.*, vitilis Fr., *A.*, vulgaris (Pers.) Fr., *A.*

Nolanea cetrata (Fr.) Schroet., *A.*, *C.*, *R.*, exilis Fr., *R.*, icterina Fr., *R.*, mammosa (Linn.) Fr., *R.*, papillata Bres., *A.*, *R.*, pascua (Pers.) Fr., *A.*, *C.*, *R.*, proletaria Fr., *Av.*, staurospora Bres., *A.*, *R.*

Omphalia campanella (Batsch) Fr., *R.*, maura Fr., *C.*, sphagnicola Berk., *R.*, striaepilea Fr., *R.*, umbellifera (Linn.) Fr., *Av.*, *R.*, umbilicata (Schaeff.) Fr., *R.*

Paneolus campanulatus (Linn.) Fr., *A.*, *R.*, papilionaceus (Bull.) Fr., *C.*, *R.*, sphinctrinus Fr., *C.*, *R.*

Panus stipticus (Bull.) Fr., *R.*, torulosus (Pers.) Fr., *Av.*, *C.*, *R.*

Paxillus atrotomentosus (Batsch) Fr., *A.*, *C.*, *R.*, giganteus (Sow.) Fr., *C.*, *R.*, involutus (Batsch) Fr., *C.*, *R.*

Peniophora hydnoides Cke. & Massee, *R.*, sanguinea (Fr.) Bres., *R.*

Phlebia merismoides Fr., *R.*

Pholiota flammans Fr., *A.*, *R.*, mutabilis (Schaeff.) Fr., *Av.*, *R.*

Pleurotus applicatus (Batsch) Berk., *R.*, ostreatus (Jacq.) Fr., *R.*, porrigens (Pers.) Fr., *A.*, *R.*

Pluteus cervinus (Schaeff.) Fr., *Av.*, *R.*

Polyporus adustus (Willd.) Fr., *R.*, amorphus Fr., *C.*, betulinus (Bull.) Fr., *Av.*, *R.*, leucomelas (Pers.) Fr., *Av.*, *R.*, nummularius (Bull.) Quél., *R.*, perennis (Linn.) Fr., *Av.*, *R.*, rutilans (Pers.) Fr., *R.*, Schweinitzii Fr., *R.*

Polystictus abietinus (Dicks.) Fr., *A.*, *Av.*, *R.*, hirsutus (Wulf.) Fr., *C.*, versicolor (Linn.) Fr., *Av.*, *R.*

Psaliota arvensis (Schaeff.) Fr., *R.*, campestris (Linn.) Fr., *C.*, *R.*, comtula Fr., *R.*

Psathyra fibrillosa (Pers.) Fr., *R.*, gossypina (Bull.) Fr., *R.*, pennata Fr., *R.*

Psilocybe elongata (Pers.) Fr., *R.*, foenisecii (Pers.) Fr., *C.*, *R.*, semilanceata Fr., *C.*, *R.*

Ptychogaster albus Cda., *R.*

Rozites caperata (Pers.) Karst., *R.*

Russula adusta (Pers.) Fr., *A.*, *R.*, atropurpurea (Krombh.) Maire, *A.*, *Av.*, caerulea Cooke, *A.*, *Av.*, *R.*, claroflava Grove, *A.*, *R.*, cyanoxantha (Schaeff.) Fr., *R.*, decolorans Fr., *C.*, delica Fr., *R.*, densifolia (Secr.) Gill., *A.*, *C.*, *R.*, drimeia Cooke, *A.*, *R.*, emetica (Schaeff.) Fr., *A.*, *C.*, *R.*, exalbicans Secr., *R.*, foetens (Pers.) Fr., *Av.*, *C.*, *R.*, fragilis (Pers.) Fr., *A.*, *Av.*, *R.*, gracillima J. Schaeffer, *R.*, heterophylla Fr., *A.*, *Av.*, *C.*, *R.*, incarnata Quél., *Av.*, integra (Linn.) Bataille, *R.*, laurocerasi Melzer, *Forres*, lepida Fr., *R.*, lutea (Huds.) Fr., *R.*, luteotacta Rea, *R.*, mustelina Fr., *R.*, nauseosa (Pers.) Fr., *A.*, *R.*, nigricans (Bull.) Fr., *A.*, *R.*, nitida (Pers.) Fr., *R.*, ochroleuca (Pers.) Fr., *Av.*, *R.*, olivacea (Schaeff.) Fr., *R.*, puellaris Fr., *R.*, Queletii (Fr.) Bataille, *R.*, rosea Quél., *R.*, sardonia (Fr.) Bres., *R.*, Velenoskyi Melzer & Zvara, *R.*, venosa Melzer (=sphagnicola sensu Rea), *R.*, versicolor J. Schaeffer, *C.*, *R.*, vesca Fr., *A.*, *R.*, veternosa Fr., *R.*, vinosa Lindbl., *R.*

Sistotrema confluens (Pers.) Fr., *R.*

Stereum hirsutum (Willd.) Fr., *R.*, rugosum (Pers.) Fr., *R.*, sanguinolentum (A. & S.) Fr., *R.*

Stropharia semiglobata (Batsch) Fr., *Av.*, *R.*

Trametes gibbosa (Pers.) Fr., *R.*, Pini (Brot.) Fr., *Av.*

Tremella encephala (Willd.) Quél., *R.*

Tricholoma acerbum (Bull.) Fr., *R.*, columbetta Fr., *Av.*, *R.*, coryphaeum Fr., *R.*, decorum (Fr.) Quél., *A.*, *R.*, fulvum (DC.) Fr., *R.*, imbricatum Fr., *A.*, *R.*, melaleucum (Pers.) Fr., *R.*, portentosum Fr., *A.*, psammopum Kalchbr., *R.*, rutilans (Schaeff.) Fr., *A.*, *C.*, *R.*, saponaceum Fr., *A.*, *C.*, *R.*, sejunctum (Sow.) Fr., *R.*, *A.*, ustale Fr., *R.*

Tubaria furfuracea (Pers.) W. G. Sm., *R.*

GASTEROMYCETES

Bovista nigrescens Pers., *A.*, *R.*, plumbea Fr., *Av.*, *R.*
Cynophallus caninus (Huds.) Fr., *R.*
Lycoperdon caelatum (Bull.) Fr., *R.*, depressum Bon., *R.*, perlatum Pers., *C.*, *R.*, pyriforme (Schaeff.) Pers., *R.*, saccatum (Vahl) Fr., *R.*, umbrinum Pers., *A.*, *C.*, *R.*, velatum Vitt., *R.*
Phallus impudicus (Linn.) Pers., *R.*
Rhizopogon luteolus Fr., *A.*
Scleroderma aurantium Pers., *R.*, verrucosum (Vaill.) Pers., *R.*
Sphaerobolus stellatus (Tode) Pers., *R.*

UREDINALES

Chrysomyxa Empetri (Pers.) Rostr., *A.*
Coleosporium Euphrasiae (Schum.) Wint., on *Euphrasia*, *Av.*, *C.*, *R.*, on *Rhinanthus*, *C.*
Cronartium ribicola Dietr., teleuto, *R.*
Gymnosporangium Juniperi Link, aecidia on *Sorbus*, *Av.*, *C.*, *R.*
Melampsora Larici-caprearum Kleb., *C.*, Rostrupii Wagn., *R.*
Melampsoridium betulinum (Pers.) Kleb., *Av.*, *C.*, *R.*
Milesina Blechni Syd., *A.*
Phragmidium disciflorum (Tode) James, *Av.*, *C.*, Rubi-idaei Karst., *C.*
Puccinia Andersoni on *Cirsium heterophyllum*, B. & Br., *C.*, Calthae Link, *C.*, Chaerophylii Purt., *C.*, Cirsii Lasch, *R.*, coronata Cda., *R.*, expansa Link, *C.*, Festucae Plowr., *C.*, holcina Erikss., *C.*, Hypochaeridis Oud., *C.*, obscura Schroet., *C.*, Polygoni-vivipari Karst., *C.*, Violae (Schum.) DC., *Av.*, *C.*, *R.*
Pucciniastrum pustulatum Diet., on *Epilobium montanum*, *C.*
Thecopsora Vaccinïorum Karst., *C.*, *G.*
Uredo anthoxanthina Bubák, on *Anthoxanthum odorata*, *C.*
Uromyces Trifolii Lév., *C.*

USTILAGINALES

Entyloma microsporum Schroet., *C.*, *R.*
Cintractia Caricis (Pers.) Magn., *R.*
Tilletia decipiens Wint., on *Agrostis vulgaris*, *R.*, Rauwenhoffi Fisch. de Wald., on *Holcus*, *C.*
Ustilago Avenae (Pers.) Jens., *C.*, *G.*, *R.*, Caricis Fuck., *C.*, Scabiosae (Sow.) Wint., *A.*, *C.*, *R.*, violacea (Pers.) Wint., on *Lychnis dioica*, *Av.*, *R.*

PYRENOMYCETES

Bertia moriformis (Tode) de Not., *R.*, on *Fagus* and *Tilia*, *R.*
Claviceps microcephala (Wallr.) Wint., on *Holcus* and *Anthoxanthum*, *C.*, *R.*, on *Glyceria fluitans*, *C.*, on *Nardus*, *R.*
Cordyceps ophioglossoides (Ehrh.) Link, *A.*, *C.*
Cucurbitaria Laburni (Pers.) Ces. & de Not., *C.*
Diatrype Stigma (Hoff.) Fr., on *Betula*, *R.*
Diatrypella favacea (Fr.) Ces. & de Not., on *Betula*, *R.*
Elaphomyces granulatus Fr., *A.*
Epichloe typhina (Pers.) Tul., *A.*, *R.*
Erysiphe graminis DC., *R.*, Polygoni DC., *C.*
Fabraea Ranunculi Karst., on *Ranunculus repens*, *C.*
Hypoxylon multiforme Fr., *Av.*
Leptosphaeria acuta (Mont.) Karst., *R.*
Melanconis stilbostoma (Fr.) Tul., *R.*
Microsphaera Grossulariae Lév., *A.*
Mycosphaerella Rumicis (Desm.) Grove, *R.*
Naumovia abundans Dobrozr., *C.*

Physalospora crepiniana Sacc. & March., on *Empetrum*, *C.*
Phyllachora graminis (Pers.) Fuck., *C.*, sylvatica Sacc. & Speg., on *Festuca rubra*, *Av.*
Sphaerotheca pannosa (Wallr.) Lév., *R.*, Humuli (DC.) Burr., *R.*
Stigmatea Robertiani Fr., *R.*
Uncinula Aceris (DC.) Sacc., *Av.*
Xylaria Hypoxylon (Linn.) Grev., *R.*

DISCOMYCETES

Cenangella pinastri (Tul.) Sacc., *C.*
Cenangium Abietis (Pers.) Duby, *A.*
Coryne sarcoides (Jacq.) Tul., *A.*, *C.*
Dasyscypha virginea (Batsch) Fuck., *R.*
Mollisia cinerea (Batsch) Karst., *C.*
Orbilia xanthostigma Fr., *R.*
Peziza aurantia Pers., *A.*, *R.*
Pseudopeziza Ranunculi (Wallr.) Fuck., *C.*
Rhizina inflata (Schaeff.) Karst., *A.*
Rhytisma acerinum (Pers.) Fr., *R.*
Sclerotinia Curreyana (Berk.) Karst., *sclerotia*, *Av.*, *R.*
Taphrina aurea (Pers.) Fr., *Av.*, *R.*
Tympanis conspersa Fr., *A.*

HYSTERIALES

Lophodermium pinastri (Schrad.) Chevall., *C.*

PHYCOMYCETES

Physoderma Menyanthis de Bary, on *Menyanthes*, *A.*
Phytophthora infestans (Mont.) de Bary, *R.*
Plasmopara nivea (Unger) Schroet., *Av.*
Protomyces macrosporus Unger, on *Aegopodium*, *C.*, *M.*
Spinellus fusiger (Link) van Tiegh., on *Mycena pura*, *R.*
Synchytrium Succisae de Bary & Wor., *M.*, *R.*

DEUTEROMYCETES

Actinonema Rosae (Lib.) Fr., *Av.*
Bispora monilioides Cda., *C.*
Cercospora beticola Sacc., *Av.*
Cladosporium herbarum (Pers.) Link, on *Rhinanthus* capsules, *C.*
Dilophospora Alopecuri Fr., on *Holcus mollis* and *Agrostis*, *Av.*
Hadrotrichum virescens Sacc. & Roum., on *Agrostis*, *Av.*
Helminthosporium Avenae Eid., *Av.*, *G.*
Marssonina Potentillae (Desm.) Sacc., *R.*
Mastigosporium album Reiss, *C.*, *R.*, var. muticum Sacc., on *Dactylis*, *C.*, *R.*
Ovularia destructiva (Plowr. & Phill.) Mass., *A.*, *C.*, obliqua (Cke.) Lindau, *Av.*
Phleospora Heraclei Petr., *C.*
Phoma Grossulariae Schulz. & Sacc., *R.*, Urticae Schulz. & Sacc., *R.*
Phyllosticta Tormentillae Sacc., *R.*
Polythrincium Trifolii Kunze, *C.*
Ramularia Cirsii Allesch., *R.*, lactea (Desm.) Sacc., *C.*, Rhei Allesch., *R.*, Tulasnei Sacc., *R.*, Urticae Ces., *R.*
Rhinotrichum Thwaitesii B. & Br., *R.*
Scolecotrichum graminis Fuck., on *Aira caespitosa*, *Av.*
Sepedonium chrysospermum (Bull.) Fr., *R.*
Septoria Ribis Desm., *R.*, scabiosicola Desm., *G.*, *R.*, stemmatea (Fr.) Berk., (Depazea stemmatea Fr.) *R.*
Sphaceloma Rosarum (Passer.) Jenk., *Av.*

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MYCETOZOA FOUND DURING THE FORAY AT AVIEMORE

5–12 September 1938

By M. W. REA

The weather during the foray was fine except on the Tuesday when the afternoon turned out wet. August had been dry and that may have had some influence on the emergence of Mycetozoa. Showery weather followed by a short spell of warm dry conditions is most favourable. Most of the specimens collected were still in the plasmodium stage. Some of these ripened well, others imperfectly, which made identification difficult. One or two formed a sclerotium after creeping about for several weeks on the substratum, so did not form sporangia.

The pine woods of Rothiemurchus were carpeted with heather in full bloom, against which the bright yellow plasmodium of *Fuligo muscorum* and *Leocarpus fragilis* showed up well in places on the grass and heather bordering the roadside. The coral pink plasmodium of *Tubifera ferruginosa* was collected several times from pine stumps. A few other species occurred on stumps of deciduous trees, e.g. *Stemonitis fusca* in the plasmodium stage. A disused woodyard at Loch an Eilein showed several large patches of ripe and unripe *Lycogola epidendrum*, *Ceratiomyxa fruticulosa* in the plasmodial stage and what turned out to be an anomalous form of *Dictydium cancellatum*. Several species were obtained from a woodyard just outside Aviemore, including very fine specimens of *Ceratiomyxa fruticulosa* and an interesting form of *Amaurochaete cribrosa*, in which uneven papillae occur on the surface. Miss Lister says: "The description refers to the smooth aethalium only: Mr Camms found *A. cribrosa* near Birmingham and his specimen had on re-examination, uneven papillose aethalia as well as those with a smooth cortex." Three days were spent collecting in the pine woods of Abernethy Forest near Boat of Garten. The best finds were made here, including *Physarum rubiginosum*, new to the British Islands. It was found three different times on twigs, but in the plasmodial stage. These ripened but not quite normally. Miss Lister thought at first that one specimen was *Cienkowskia reticulata*, another *Physarum lateritium*, as it formed "long, narrow plasmodiocarps, but the spores were too large and dark for *P. lateritium*", and the third *P. rubiginosum*. She finally decided that all three specimens were *P. rubiginosum*. Some collecting

was done in pine woods nearer Aviemore but no species were found that had not occurred elsewhere. *Licea flexuosa* was the most common species in Abernethy Forest, then *Leocarpus fragilis* both ripe and unripe and *Fuligo muscorum* in the plasmodium stage. *Physarum nutans* was also common. A surprising feature was the almost entire absence of the genus *Trichia*, two sporangia of *T. Botrytis* only being collected. The autumn foray of 1927 had a list of forty species but there were several members collecting. However among the twenty-seven species obtained, seven had not been found in 1927. Miss Lister kindly examined the doubtful specimens and wrote notes on a few of the more interesting finds, which she suggested might be included in this account. She remarks: "Your Scotch specimens have given me much interest and some puzzling." The normal form of *Physarum viride* was fairly common in Abernethy Forest but one fine specimen had sporangia much larger than usual and included were several bright red sporangia. "Except for the colour they are so similar to the yellow sporangia, that it seems as if they must be one development. This is interesting and surprising. The stalks of all were similar, yellowish brown below, red in the upper part, yellow again the uppermost slender part."

"*Stemonitis hyperopta* Meylan, Abernethy Forest, 8. ix. 38 on pine wood. This specimen consisted of about twenty-four minute dark brown ovoid sporangia on short stalks. They measure about 1 mm. in total height and are loosely arranged in two groups. They have not matured perfectly. The dark capillitium resembles that of *Comatricha laxa*, but the presence of short slender branchlets arising from many of the main branches suggests that under more favourable conditions, a denser, more *Stemonitis*-like network might have been formed. The pale spores measure 4–6 μ, and are marked like those of *Stemonitis hyperopta*, that is with faint raised lines connecting small patches of close reticulation, or they may be very loosely reticulated all over. If this form were constant it might well represent a new species of *Comatricha*, but being a somewhat imperfect development, it seems better to regard it for the time as a weak form of *Stemonitis hyperopta*."

In the following list *R.* stands for Rothiemurchus Forest and *A.* for Abernethy Forest.

Ceratiomyxa fruticulosa (Mull.) Macbr., *R.*, on logs in woodyard and posts and sawdust at Loch an Eilein.
Physarum nutans Pers., *A.*, var. leucopheum Lister, *A.*, viride Pers., *A.*, *rubiginosum Fr., Symb. Gast., 21 (1817), *A.*
Fuligo septica (L.) Gmel., *R.*, *A.*, on stumps, var. candida, woodyard, *R.*, muscorum Alb. & Schwein., *R.*, *A.*
Craterium minutum Fr., *A.*
Leocarpus fragilis Rost., *R.*, *A.*
Didymium melanospermum Macbr., *A.*

*Leptoderma iridescens Lister, *A.*
Stemonitis fusca Roth., *R.*, *splendens Rost. var. flaccida Lister, *R.*, *flavogenita Jahn, *A.*, hyperopta Meylan?, *A.*
Comatricha nigra (Pers.) Schroet., *A.*, *R.*
Enerthenema papillatum Rost., *A.*
*Amaurochaete cribrosa (Fr.) Sturgis, logs in woodyard, *R.*
*Cribraria argillacea Pers., *A.*
Dictydium cancellatum Macbr., *R.*, *A.*, var. anomalum Jahn, *R.*, with branching ribs.
Licea flexuosa Pers., *R.*, *A.*
Tubifera ferruginosa Gmel., *R.*
*Enteridium liceoides Lister, *A.*
Lycogola epidendrum Fr., *R.*, *A.*
Trichia Botrytis Pers., *A.*
Arcyria cinerea Pers., *A.*, denudata Sheldon *A.*, incarnata Pers., *R.*, *A.*

Those species marked * were not recorded from the Foray in 1927.

(*Accepted for publication 7 August* 1939)

AGARICS AT AVIEMORE

By A. A. PEARSON, F.L.S.

(With Plate IX)

A striking feature of the 1938 foray in the Aviemore district was the abundance of *Paxillus atrotomentosus* and *Cantharellus cibarius*. Some rare species of agarics were gathered but not so plentifully as in previous forays in this neighbourhood. We were disappointed not to find more species of *Cortinarius*, though a few uncommon species were brought in. Some interesting species of *Russula* were gathered of which descriptions have not previously appeared in English. These are described in the following notes, together with a few of the more interesting species of other genera.

Russula rosea Quélet, *Fl. myc. Fr.* p. 349, (1888)

Pileus 6–7 cm. subglobose then flat, firm when young, less so when fully expanded, dry, mat, granular *sub lente* with shallow veins, cuticle separable two-thirds to centre, margin incurved at first then straight, colour a delicate pink mixed with cream, often cream in the middle and pink at the margin. *Gills* crowded, thin, about 5 mm. wide, rounded near margin, tapering to stem, edge smooth, white, mostly one size, bifurcated near stem, a few forked from various points. *Stem* cylindrical, base equal or pointed, length 4–5 cm., thickness 10–12 cm., firm then flabby, dry, striate with raised lines, white, not colouring with handling. *Flesh* white. *Taste* mild. *Smell* none. *Spores* ivory white in mass (B of Crawshay), subglobose about $8 \times 6{\cdot}5$ with shallow warts and partial faint or thick reticulation seen under 1500 magnification. *Cystidia* on gill edge sparse, blunt, not turning blue with sulphovanillin; no cystidia on pileus. *Chemical reaction* of flesh: with sulphovanillin a brilliant carmine red; with ferrous sulphate, faint salmon pink.

Habitat in leafy woods. Not uncommon. Aviemore, Scotland under birch. Sussex in oak woods.

According to some authors this is Krombholz's *Russula aurora*, to which it is closely allied, the colour reaction to sulphovanillin being the same, but it is so different in colour and size that it is better to regard it as a separate species. It is often determined as *R. lepida* from which it differs in the non-powdery pileus and separable cuticle, and the reaction to sulphovanillin.

Russula vinosa Lindblad, *Svampbok*, p. 57 (1901)

Pileus 7–8 cm. (4–15 cm. is the full range), convex then flat and finally subinfundibuliform, firm, viscid then dry, glabrous or somewhat mat, cuticle peeling half way to centre, vinaceous purple, darker in centre (Indian lake, dahlia carmine, dark maroon purple of Ridgway in our specimens, but other colour blendings occur), the margin sometimes clothed with a white pubescence, edge incurved, rounded, smooth at first, later tuberculate. *Gills* crowded, thin, white then cream, edge often reddish near margin of pileus, arcuate (edge straight and curved above) rounded near margin, adnexed to stem with slight upward curve, all one size, bifurcated near stem with occasional anastomozing gills. *Stem* 6–7 cm. long, about 2 cm. thick, cylindrical with base equal, thickened or attentuated, spongy, dry, rugulose with raised lines *sub lente*, white, rarely with a tinge of pink, then turning a blackish grey. *Flesh* white then slowly red and finally blackish grey. *Taste* mild. *Smell* none, or "fruity" and when old like honey. *Spores* pale salmon-yellow in mass (F of Crawshay's chart), ovate, somewhat variable in size mostly 10–10·5 × 8·5–9 μ, echinulate with isolated spines and an occasional trace of very fine reticulation when seen under 1500 magnification. *Cystidia* on gills abundant on edge and face, blunt or pointed, turning blue with sulphovanillin: no cystidia on pileus.

Habitat in coniferous woods. Rothiemurchus Forest, 6 Sept. 1938.

Closely allied to *Russula decolorans* Fr. and *R. claro-flava* Grove; easily recognized by the colour of the pileus and stem which turn blackish grey when dry. Bresadola has figured it (*Icon. Mycol.* f. 409) under the name *Russula depallens* Pers. Before the stem blackens it might be taken for a form of *R. integra* (Linn.) Fr.

Russula gracillima J. Schaeffer in *Z. Pilzkunde* IV, 105 (1931); *Ann. Mycol.* XXXI, 482 (1933) and XXXII (1934), Tab. III.

Pileus 1·5–6 cm. (usually 3–4 cm.), sometimes convex at first but usually flat with shallow umbo, depressed round the umbo, thin but fairly firm, cuticle separable half way, at first viscid, smooth and glabrous, somewhat rugulose on the disc, dark olive-green in the centre blending into greyish green and a rosy pink round margin which is smooth at first and minutely tuberculate later. *Gills* crowded, white at first, then light cream, rounded near margin of pileus, and narrowing towards them, adnexed, subdecurrent or free, thin, fragile, usually all one size, width 2–3 mm., edge straight and smooth. *Stem* slender, 4–5 cm. long, attenuated above, somewhat club-shaped below, brittle or fairly firm consistence, spongy inside, dry, smooth or somewhat rugulose, white above, flushed with a

beautiful rosy pink in middle, white at base which stains brown. *Flesh* white. *Taste* faintly but definitely acrid. *Smell* pleasant. *Spores* cream in mass (C of Crawshay's chart), ovate, echinulate with no trace of reticulation, 8–9 × 7–7·5 μ (the original description gives 8–10 × 6–8 μ). *Cystidia* more abundant on face than on edge of gill, lanceolate often with a long point turning dark blue with sulphovanillin: similar cystidia on cuticle of pileus.

Habitat under birches. Aviemore, Scotland. 4 Sept. 1938.

An uncommon species remarkable for its striking blending of colour and slender form, as well figured by Miss E. M. Wakefield from the Aviemore specimens. Plate IX.

Russula scotica n.sp.

Pileus 4–6 cm. light to dark buff colour, convex then flat, finally depressed, cuticle separable about one-third to centre, viscid at first, smooth, polished, margin straight, regular, tuberculate. *Gills* light cream, crowded, adnexed or free, linear, width in middle 3–4 mm., fairly thick, edge straight, smooth, one size only. *Stem* white, 5–6 cm. long, 1·5 cm. thick, cylindrical, straight, base equal, fragile, of spongy texture, subviscid, somewhat rugulose and veined. *Flesh* white in pileus and stem. *Taste* mild. *Smell* none. *Spores* pale yellowish salmon in mass (F of Crawshay's chart), broadly ovate-apiculate, clearly and almost coarsely reticulated when seen under 1500 magnification, 8–9 × 8–7·5 μ. *Cystidia* abundant on gill edge, fusiform, about 8 μ wide, turning dark blue with sulphovanillin; cystidia also present on pileus 4–5 μ wide, club-shaped with slender tail and obtuse apex. *Chemical reactions* pink to ferrous sulphate, grey to sulphovanillin.

Habitat solitary or in troops; under birch Aviemore, Scotland, 3 Sept. 1938.

This *Russula* closely resembles *R. cremeo-avellanea* R. Singer which is fairly common under birches in the Pyrenees (Mediterranean side) and which differs in the non-reticulated spore and absence of cystidia on the pileus. Until more is known of the value of spore ornamentation and the stability of cuticular cystidia, it is better to record the Scottish *Russula* as a separate species.

I have to express my indebtedness to Mr F. Singer for a dried specimen of his *Russula cremeo-avellanea* and for information regarding this species.

Miss E. M. Wakefield very kindly painted specimens gathered by me in the birch woods at Aviemore. Only the pale form is shown, but some specimens were of rather deeper colour. However the pale form was more abundant and may be considered as typical.

Plate IX.

Latin diagnosis:

Russula scotica Pearson

Pileus 4–6 cm. latus, carnoso-tenuis, e convexo planodepressus, viscidus mox siccus, glaber, fulvus pallidus vel avellaneus, cutis $\frac{1}{3}$ separabilis, margine tuberculoso-striato. Lamellae pallide cremeae, confertae, aequales, postice attenuato-adnexae fere liberae, 3–4 mm. latae, sub-crassae. Stipes 5–6 cm. longus, $1\frac{1}{2}$ cm. crassus, albidus, aequalis, fragilis, spongioso-farctus, sub-viscidus, aliquantulum venoso-rugulosus. Caro alba; inodora, mitis. Sporae in cumulo: luteae (Tab. Crawshay F) subglobosae apiculatae, verruculosae, distincte reticulatae, $8–9 \times 7–7\frac{1}{2}\,\mu$. Cystidia super acie lamellae copiosa, fusoidea circa $8\,\mu$ lata; colorant obscuro-caerulea ubi Sv. Cystidia super pileo $4–5\,\mu$ dia. clavata cum cauda tenue e apice obtusa. Caro colorat rosea ubi SO^4.—grisea Sv.—nulla Ph. Hab: ad terram in betulis. Aviemore, Scotia.

Clitocybe inornata (Sow.) Fr., var. ***exilis*** n.v.

Pileus 3–4 cm. pale grey, infundibuliform, undulate, surface breaking up into squamules. *Gills* white, deeply decurrent. *Stem* slender, 7 cm. long, 3 mm. thick, grey striate base with white tomentum. *Basidia* 4-spored. *Spores* fusiform white in mass 8–10 $\times$ 3–3·5 μ. *Cystidia* none.

Differs from the type in the pure white deeply decurrent gills and slender build. The fusiform spores are so characteristic that it would hardly be justifiable to separate this from *C. inornata*.

Clitocybe inornata (Sow.) Fr. var. ***exilis*** Pearson. *Pileo infundibuliforme lamellis albidis puris vere decurrentibus et statu graciliore.*

Cooke, Illustrations, Pl. 162 (110) of a variety of *Clitocybe senilis* Fr. corresponds to this agaric.

Naucoria bohemica Velenovský, *Ceské Houby*, p. 527 (1921) = *N. scorpiodes* Fr. sensu Lange.

Ill: Bull. Soc. Myc. Fr. LI. Pl. III (1935).

Pileus 1–4 cm. hygrophanous, dark bay-brown then café au lait, paler near the margin, striate when fresh, obtusely umbonate then depressed round the umbo, smooth, margin incurved then repand and undulate. Fleshy in the centre, thin elsewhere. *Gills* somewhat crowded, greyish then dull clay, adnate then free, ventricose, edge white, more or less fimbriate. *Stem* straight or curved, 3–7 cm. long, 3–5 mm. thick, clothed with white silky fibrils, furfuraceous at the apex, solid then hollow, fragile. *Flesh* brownish, white when dry.

No smell or taste. *Spores* lemon-shaped somewhat flattened on one side, about 12 × 8–8 μ, warted. *Basidia* with 2 sterigmata. Marginal cells to gills, cylindrical or club-shaped, 30–40 × 3–8 μ.

Looking like a small *Cortinarius* but with no trace of an arachnoid veil.

The above is the description I made of specimens gathered at Aviemore, September 1927, round a small pond at the back of Aviemore Hotel. The two-spored form I have also gathered near Frant, Sussex, and elsewhere. There is also a four-spored form which I found at Littlehampton, Sussex, which was rather redder. Both these forms have been fully described by R. Maire and R. Kühner in *Bull. Soc. Myc. Fr.* LI, 197–203 (1935) and the additional information given may be summarized as follows:

An arachnoid veil is fugacious, and manifest only in very young specimens. The colour of the pileus varies from chocolate to reddish brown. The cuticle of the pileus is made up chiefly of globose cells and a few papillate hyphae. The spores are subfusoid, almond-shaped, warted, with apical papilla, thick walled except at the two ends, 10·5–15 × 6·5–9 μ in the tetrasporous form and 13–19 × 7·5–10 μ in the bisporous form. It occurs in wet places but is not associated with the alder as are most of the group *Alnicola* Kühner to which the species presumably belongs, but as an arachnoid veil has been seen, the doubt still remains whether it should not be described as *Cortinarius* (*Hydrocybe*).

J. Lange (*Agarics of Denmark*, Part XII) has recently identified this species (bispored form) with *Naucoria scorpiodes* Fr., but in his diagnosis Fries underlined the character *acie concolori integerrima*, which does not apply to the present species which has a white pubescent edge to the gills. Otherwise the Friesian description is near enough.

Cortinarius* (*Inoloma*) *cyanites Fr.

This "species magnifica" as Fries calls it in his *Monographia*, was found in Rothiemurchus Forest. We were unable to verify the observation of Fries that the stem when compressed exudes a red juice, but the flesh turned red as described.

Cortinarius* (*Inoloma*) *violaceus (Linn.) Fr.

Some noble examples of this uncommon species were growing round a small loch in Rothiemurchus Forest under birches. Some were of remarkable size, the pileus measuring 15 cm. in diameter. The cystidia on the gill edge are ventricose fusiform, some pale lilac and others filled with a dark violet granular substance.

***Cortinarius* (*Phlegmacium*) *turmalis* Fr.**

At a first glance the specimens suggested *Rozites caperata* on account of the white veil on young specimens, but the small subfusiform spores, 8–9·5 × 4–5 μ, as figured by Konrad and Maublanc in their *Icon. Sel. Fung.* Pl. 136 made it possible to place it with some certainty. Subsequently I was able to confirm this from a spore print I possessed, obtained from a specimen named by Dr René Maire which we gathered in Spain, October 1935. This species is the *Cortinarius claricolor* of some authors, but our specimens certainly did not have the floccose squamulose stem underlined in the Friesian diagnosis of *Cortinarius claricolor*, which is variously interpreted. Cooke's figure 814 (790) of *Cortinarius triformis* var. *Schaefferi* probably represents the bulbous form of *C. turmalis* which may have the stem base either equal or swollen.

***Inocybe sambucina* Fr.**

Pileus 6–8 cm. silky, smooth, closely fibrillose, white at first then pale yellow (straw-yellow of Ridgway) broadly umbonate, fissured at the thin margin when old. *Gills* 5–8 mm. wide, crowded, white at first then dingy when the spores fully develop, ventricose, adnate or adnexed, edge straight or somewhat undulate. *Stem* white, short usually but 8 cm. in one specimen, fibrillosely striate with raised ribs, 1·5 cm. thick, very solid, base equal or sub-bulbous. *Flesh* white. *Smell* of new meal. *Spores* snuff-brown in mass, elongate subamygdaliform, 8–10 × 4–5 μ. *Cystidia* muriculate, ventricose with short neck, 50–60 × 15–20 μ.

Habitat pine woods.

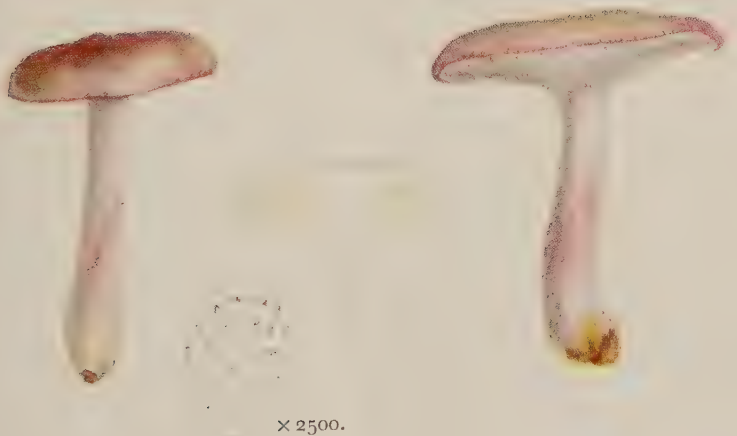
This uncommon species was gathered both in Abernethy Forest and in the pine woods at Forres. It is a remarkably stout fleshy *Inocybe*. Bresadola's figure in *Iconographia Mycologica* Tab. 750 is good. In his description he says the gills are crowded, like our specimens, but Heim in *Le Genre Inocybe* says they are "peu nombreuses". However as Fries himself describes the gills as "confertae" it is probable that Heim had another species in view.

The epithet "sambucina" (? elder) is rather puzzling; Fries states that the species grows in pine woods. Possibly he thought the robust stem looked like a stick of elder pith.

(*Accepted for publication* 7 *August* 1939)

Russula scotica Pearson.
Aviemore 4. IX. 38.

× 2500



× 2500.

Russula gracillima J. Schaeffer.
Aviemore 4. IX. 38.

NEW AND INTERESTING PLANT DISEASES.

By W. C. MOORE
Plant Pathological Laboratory, Harpenden

(With Plates X and XI)

3. A shoot wilt of *Prunus triloba* caused by *Botrytis cinerea* Pers.

In the spring of 1936 a few shoots on a bush of *Prunus triloba* var. *floro pleno* growing in my garden at Harpenden, wilted suddenly shortly after flowering. Some of the faded and decaying flower clusters were covered with fructifications of *Botrytis*, but apart from cutting off and burning the affected shoots no attention was paid to the matter. The following year the weather was very wet for some weeks before the end of May, and, shortly after the bush had flowered, many of the shoots again wilted suddenly, while similar symptoms were observed on a second bush elsewhere in Harpenden. The one-year-old flowering shoots were attacked chiefly, but some of the new shoots, at that time about 6–7 in. long, also suffered. In the flowering shoots the disease was almost invariably associated with a faded, dying flower or flower cluster, which more often than not was covered with *Botrytis*. The bark above and below the bud bearing these flowers was slightly sunken over a distance of 2–3 in., and was rather darker than the surrounding healthy parts. The foliage below the girdled area was still fresh and healthy, while the leaves on the distal portion of the shoot had wilted and were hanging limply. When the shoot was cut longitudinally two days after wilting, the bark in the affected region was observed to be brown and dead and the wood was also slightly discoloured. In one or two instances the disease originated at the spot where a stray, wind-blown petal (on which *Botrytis* developed) had become adherent to an internode of a one-year-old twig. The current season's shoots, on the other hand, appeared to be directly attacked at or near the base (see Pl. X, fig. 1). The wilted leaves soon became brown and dry and, if left untouched, they remained hanging on the dead shoots throughout the season.

The spring of 1938 was exceptionally dry at Harpenden and the disease was not observed that year. In 1939 flowering coincided more or less with a week of hot, sunny weather beginning on 7 April. This was followed by showery weather, but the bush had been pruned as soon as the flowers faded and shoot wilt was not seen until 22 May, and then only on two one-year-old shoots that had

not been cut back. The other bush kept under observation showed no sign of wilting, but towards the end of May the disease was very conspicuous in a third garden in Harpenden on a young half-standard tree of the variety *floro pleno*. A few of the current season's shoots were wilted but the most striking symptom here was wilting and death of the leaf clusters that develop on very short spurs below the old flower buds. On some shoots only one leaf had wilted and turned brown; on others the stalks of all the five or six leaves comprising the cluster were almost black and the leaves were brown and dead (see Pl. XI, fig. 3).

In 1937, and again in 1939, pure cultures of a *Botrytis* belonging to the *cinerea* group, and identical with that fruiting on the withered flower parts, were obtained by transferring under aseptic conditions small pieces of affected bark and wood to agar plates. The ovoid or pear-shaped conidia of this fungus measured $11–15 \times 7–10\,\mu$ (average $11{\cdot}8 \times 8{\cdot}5\,\mu$) and were borne on sparsely branched conidiophores, pale to deep brown below, almost colourless above. Large, black, flat sclerotia developed freely in culture but they have not been seen on the host. At the end of May 1939 pure cultures of the *Botrytis* were used for inoculating several shoots of the current season and of the second year. The fungus was inserted below T-shaped cuts made in the bark and the inoculated parts were wrapped in sheet cellophane. The shoots of the current season wilted within three days and the older twigs showed symptoms typical of the disease within a week (see Pl. X, fig. 2). The *Botrytis* was re-isolated without difficulty from the wood and bark thus artificially infected. Control shoots, treated in the same manner except that no fungus was inserted in the cuts, remained healthy throughout the summer.

It is very improbable that the shoot wilt described above is new to this country, but it does not appear to have been recorded here up to the present. The disease bears a striking resemblance to Wither Tip and Blossom Wilt of plums caused by *Sclerotinia laxa* Aderh. & Ruhl., a fungus that may indeed attack *Prunus triloba*, according to Weber (1926), though it has not been observed by me on this host. In Germany, Laubert (1923) very briefly described a shoot wilt of *P. triloba* that he found associated with a species of *Botrytis*, and Klebahn (1930), in an article dealing with strains of the collective species "*Botrytis cinerea*" isolated from a wide range of hosts, referred to a strain on *Prunus triloba* which he regarded as parasitic, though he did not test it. He called this strain *Botrytis cinerea* f. *Pruni trilobae* and stated that it closely resembled another form (f. *Primulae sinensis*) occurring on *Primula sinensis*. The ellipsoidal to egg-shaped conidia of f. *Pruni trilobae* measure $7–11 \times 4–6\,\mu$ (average $9 \times 5\,\mu$) and are therefore much smaller than those of the strain isolated in England.

Fig. 2.

Fig. 1.

Fig. 4.

Fig. 3.

Shoot wilt due to *Botrytis* is not likely to occur unless the weather is wet or showery during or immediately after the flowering period, and the disease can largely be avoided, even in a wet season, by cutting the flowering twigs hard back *as soon as the flowers fade*. Fresh shoots, up to 3 ft. long, are produced during the summer and these will flower the following spring.

Two other instances of damage to flowering shrubs by *Botrytis* may be mentioned here. In July 1939 Mr C. J. Hickman brought me a diseased branch of *Daphne Mezereum* cut from a plant growing in a private garden at Birmingham. The shoot bore a number of mature, red berries, but some of these were rotting and covered with *Botrytis*, which had apparently passed back through the berries into the stem and caused wilting and death of the distal portion of the shoot (see Pl. XI, fig. 4). About the same time, Miss E. M. Wakefield informed the Plant Pathological Laboratory that she had received from Letchworth a specimen of *Cotoneaster frigida* attacked by *Botrytis* on the woody stems, exactly similar to the *Botrytis* die-back commonly observed in gooseberry bushes. The affected plant formed part of a hedge and it is possible that the constant clipping of the hedge had facilitated entry by the *Botrytis*.

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EXPLANATION OF PLATES X AND XI

Plate X

Fig. 1. Current season's shoot of *Prunus triloba* killed by *Botrytis cinerea*. One-year-old wood unaffected. Natural infection.

Fig. 2. One-year-old shoot of *Prunus triloba* killed by inoculation with *Botrytis cinerea*. Inoculated 26 May; the shoot wilted on 29 May and was cut off and photographed on 2 June.

Plate XI

Fig. 3. Twig of *Prunus triloba* showing wilting of short spurs and of the current season's shoot. Natural infection.

Fig. 4. Shoot of *Daphne Mezereum* killed by *Botrytis*. Natural infection. Note the shrivelled berries at the junction between healthy and wilted parts.

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ADDITIONAL NOTES ON THE SYSTEMIC INFECTION OF *LOLIUM*

By KATHLEEN SAMPSON, M.Sc.
University College of Wales, Aberystwyth

Introduction

Lolium perenne Linn. and other species of the genus carry mycelium which ramifies in the vegetative and floral organs without apparent injury to the host cells and is distributed by vegetative propagation and by seed (Sampson, 1935). In previous studies two types of mycelium were brought into culture. Each possesses certain distinctive features which have remained constant over a period of study embracing six generations of the host plant. For convenience they were designated as the first and second endophytes (Sampson, 1937). The second type, which grows more readily on culture media, has been introduced into seedlings of a fungus-free race of perennial rye-grass and reisolated from the mature plant. Mycelium from a culture on malt agar was placed in a slit at the base of the shoot which was firmly bound with cellophane to retain the moisture. Ten plants among thirty-seven inoculated became infected, all the controls remaining fungus-free. Seventy-one inoculations made in a similar manner with the first endophyte were unsuccessful.

Since the plants which yielded endophytes 1 and 2 were derived by seed or vegetative propagants from two individuals only, it seemed desirable to seek for new material and this led to the discovery of mycelium in *Festulolium loliaceum* (Huds.) C. E. Hubbard (*Festuca loliacea* Huds.). Systemic infection of this plant, recorded here for the first time, is in conformity with its supposed origin as a natural hybrid between *Festuca pratensis* Huds. and *Lolium perenne* Linn.

A number of fresh isolations have been made from plants of *L. perenne* of diverse origin but these and the isolates from the hybrid have remained sterile like the original types. They provide no further clue to the identity of the fungus or fungi concerned. The paucity of diagnostic characters makes it impossible to decide if all isolations are strains of a single organism though the fact that some of the new ones possess some characteristics of both types lends support to this view. To facilitate discussion the distinguishing features of endophytes 1 and 2 based on the original isolations are set out in Table I.

Table I. *Showing the distinguishing features of the two types of mycelium isolated from* Lolium perenne

	Endophyte (1) (isolated from No. 1971)	Endophyte (2) (isolated from No. 1972)
1.	Endophytic mycelium sparsely branched, deeply staining	Endophytic mycelium branched, highly vacuolate and faintly staining
2.	Forms conspicuous zone of mycelium outside aleurone cells	Mycelium present in seed but does not form a conspicuous zone
3.	Fails to grow from pith placed on agar media. Isolated by use of egg	Grows readily from pith lying in contact with agar
4.	Growth in culture is almost entirely glabrous	Forms plentiful aerial mycelium with spirally coiled hyphae and micro-conidia. Yellow stain on oatmeal agar

Festulolium loliaceum (Huds.) C. E. Hubbard

Stems were examined from over fifty plants of this hybrid originating in six districts. Those from Appleton, Norfolk, and Llwynygo near Oswestry were fungus-free, but one or more plants from four other districts carried mycelium from which numerous isolations were made. Results obtained in different seasons (1936–8) were confirmatory.

The cultures could be arranged without difficulty into two groups; those from Brentford, Middlesex, and Buttington, Montgomery, resembled the first endophyte while those from Port Meadow, Oxford, and Castle Eaton, Wiltshire, agreed with the second endophyte (Table I). Some points of detail deserve mention. In one isolation experiment the mycelium in a particularly large piece of pith from one of the Buttington plants gave appreciable growth on agar and the fungus was successfully isolated by transferring this to egg three weeks later. This is the only occasion that the first endophyte has been isolated when pith was placed directly on an agar medium. Cultures prepared from the Buttington plants always developed more aerial mycelium than the type No. 1971 but they were classed without hesitation as endophyte 1.

Isolations from the Oxford and Wiltshire plants possessed the cultural characteristics of endophyte 2 listed in Table I, but the mycelium present in the pith was sparsely branched and deeply staining like that of endophyte 1 in perennial rye-grass No. 1971. In microtomed preparations of tiller buds and young ovaries the abundance and staining power of the mycelium again recalled the first endophyte. Unfortunately *Festulolium loliaceum* is sterile and the different series of plants could not be compared in regard to the presence and absence of a mycelial layer outside the aleurone cells of ripe fruits. The distribution of mycelium in the most mature ovaries available agrees with that in perennial rye-grass No. 1971,

darnel and related species, where the fungus forms a well-marked zone in ripe seed. As in perennial rye-grass, infected clones of the hybrid are easily maintained by division.

Lolium perenne Linn.

Rooted portions of perennial rye-grass were dug up from hedge-banks and roadsides near Aberystwyth, and a number of specimens were kindly sent by Miss Cayley who had collected them from old pastures in six counties of England. The presence or absence of mycelium was determined in pith scrapings, infected plants were propagated and cultures subsequently obtained. Seeds were also examined by hand sections and some ovaries were microtomed and stained with gentian violet. Among forty-two plants investigated, only five were found to be systemically infected and from each the endophyte was isolated. Plants No. 3050 (Aberystwyth) and No. 3059 (Norfolk) carried deeply staining mycelium which failed to start growth on agar but developed on the egg medium. In subcultures on agar, growth was entirely glabrous or a sparse aerial mycelium developed after some weeks. These cultures were identified as endophyte 1.

Plant No. 3057 (Lincolnshire) contained mycelium of the branching, faintly staining type which grew out readily when pith was placed on malt agar. Cream-coloured aerial mycelium with coiled hyphae and microconidia developed, and a yellow stain was produced on oatmeal agar. A zone of mycelium was absent from the seed (10 seeds examined). The characteristics were precisely those of the second endophyte.

No. 3058 (Lincolnshire) and No. 3060 (Norfolk) carried mycelium in the stems and seed which resembled that of the first endophyte but growth in culture was like that of the second. These strains correspond, therefore, with those found in the plants of *Festulolium loliaceum* obtained from Oxford and Wiltshire.

Lolium multiflorum Lam.

Italian rye-grass was not included in the first series of experiments (1933–5) but preliminary tests indicated that in this species, fungus-free plants are more numerous than those carrying an endophytic fungus. In order to obtain material, twenty-one samples of seed representing seven countries of origin were obtained through the courtesy of Mr A. Eastham from the Official Seed Testing Station. Hand sections were cut from three grains in each sample and stained with cotton blue. Only six out of sixty-three grains showed the typical fungus layer. Samples in which the infected grains occurred were sown in boxes and subsequently twenty plants from each were

spaced out in drills. Pith scrapings were taken from the stems of a number of plants and seed was later harvested and examined.

The results show that infected plants of Italian rye-grass send up more fungus-free stems than do those of darnel or perennial rye-grass, a fact which may explain the low proportion of infected grains in the samples of seed examined. Sufficient material was obtained, however, for isolation experiments.

Strips of pith from infected stems were placed on agar and on egg media during the season 1936 but no growth took place. In this respect the mycelium present in plants of *L. multiflorum* so far examined behaves like that found in *L. temulentum* Linn. and *L. remotum* Schrank (Sampson, 1937).

Summary

Some plants of the natural hybrid *Festulolium loliaceum* (Huds.) C. E. Hubbard carry mycelia like those present in *Lolium perenne*.

A number of new isolations from this hybrid and from perennial rye-grass have been compared with those previously described as endophytes 1 and 2. Some isolates possess the mycelial characteristics of endophyte 1 while their growth in culture resembles endophyte 2.

The mycelium in *L. multiflorum* failed to grow on artificial media, agreeing in this and other respects with that present in *L. temulentum* and *L. remotum*.

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BIOLOGICAL CONTROL AND ECOLOGY OF *ARMILLARIA MELLEA* (VAHL) FR.

By R. LEACH, B.A., A.I.C.T.A.

(With Plates XII and XIII)

Introduction

I was fortunate in having to clear forty acres of forest land for a tea experimental station, an experience which enabled me to appreciate fully the planter's difficulties with regard to *Armillaria* root disease of tea in Nyasaland. Owing to international restriction there is little likelihood of many more acres of this crop being planted in that country, but *Armillaria* can cause trouble there to other susceptible economic crops of importance, such as tung (*Aleurites Fordei* and *A. montana*). Considering the world-wide distribution of *A. mellea* it is remarkable that so little is known about its ecology. This paper is an attempt to fill some of the gaps in the knowledge of the ecology of the fungus and gives additional evidence in favour of the hypothesis of biologic control published elsewhere (Leach, 1937).

Incidence of *Armillaria* root disease

Sometimes the land to be planted in tea includes patches of native gardens. The native usually clears his land by cutting down a few trees at a time without removing the stumps, with the result that *Armillaria* may remain active there for a number of years. Most tea is now planted on land cleared expressly for the purpose from virgin or regenerated forest.

Butler (1928), who visited Nyasaland in 1927, showed the planters that *Armillaria* was associated with old tree stumps and their roots, so that they now clear their land more carefully, removing as many roots as possible. It is disconcerting to find that bad patches of root disease due to *Armillaria* may still appear even when the removal of stumps is carried out up to the economic limit. Apart from the danger of damaging the texture of the soil, it is very difficult when clearing any large acreage to remove the many roots which lie deeper than 15 in. below the surface. As the fungus is often found down to a depth of 4 ft. in inspection pits, it is not surprising that even the most up-to-date methods of clearing land are insufficient to insure complete protection from this fungus, although they somewhat reduce chances of infection by it.

In Nyasaland, as in other parts of tropical Africa, *Armillaria* develops rhizomorphs sparsely, the longest one found by me being a single strand 18 in. long. Infection is caused largely by contact between the tea root and the infected tree root. There is probably little spread laterally between the younger tea bushes, the roots of which are not in contact with each other. Trenching can only be of value in Nyasaland when the original forest tree roots are no longer a source of infection and the disease is spreading laterally by contact of the roots of old tea bushes.

Little is more annoying to the planter than constantly replanting vacancies due to root disease, and when a large acreage is attacked the process seems unending. Because the scanty development of rhizomorphs prevents infection of roots from a distance, continual replacement of young tea bushes attacked by *Armillaria* has been found to be the only way in which to tackle the disease once it appears in new tea gardens. By this treatment infected patches start to recover after about the seventh year from planting and after about twelve years the disease may have disappeared.

To the inexperienced eye an affected bush seems to die suddenly, but to the experienced eye it appears unthrifty, and may show the characteristic cracking at the collar six months or even a year before it dies. Labour can easily be trained to recognize these symptoms, so that infected bushes can be removed in earlier stages of the disease than has been customary in the past. It is considered that patches of affected tea may be rectified quicker in this way than by waiting for the bushes to die before uprooting them. This method of rogueing resembles, though on a smaller scale, that proposed by Napper (1932) for the control of white root rot of rubber caused by *Fomes lignosus*.

Biologic methods of control

Although the methods of control referred to are of some assistance to the planter it has to be admitted that they are still far from satisfactory. The basic problem is to prevent *Armillaria* from infecting those roots of forest trees which remain in the soil after clearing. With this purpose in view I (1937) suggested a measure of biologic control, namely, the ring-barking of forest trees some time prior to felling, so that their roots are depleted of carbohydrates to such an extent that they cannot be invaded by *Armillaria* and are killed by fungi innocuous to healthy plantation crops. A certain amount of evidence was claimed to favour this measure.

With reference to the idea that *Armillaria* is unable to invade roots depleted of carbohydrates, Garrett (1939) suggested that the restriction might be due to the competition of organisms better able to infect the roots rather than to the absolute inability of *A. mellea*

to invade them. Even if this is correct, the object of biologic control is to find a method for insuring that the tree roots are invaded by fungi other than *Armillaria*, after the forest is cleared. Ring-barking is suggested as the most appropriate method of achieving this object. It was intended to put this idea to a thorough test but circumstances prevented this; only a few further observations and preliminary experiments could be carried out and these are described here.

As a result of carbohydrate depletion caused by *Armillaria* completely girdling the tap root of a tea bush, a few lateral roots below the girdled zone are usually invaded by *Rhizoctonia lamellifera*, which causes a dry rot of these roots. Where the dry-rotted tissues of such laterals come in contact with the tissues invaded by *Armillaria*, the latter forms a black "zone-line" and further progress is checked, *Armillaria* never progressing into the dry-rotted laterals. Pl. XII, fig. 1 shows the clear-cut "zone-line" separating the portion of a dead tea root dry-rotted by *Rhizoctonia lamellifera* and the portion rotted by *Armillaria*.

In a young plantation of *Eucalyptus* in which the undergrowth had been kept hoed down, some of the surface roots of the felled trees of "Muula" (*Parinari mobola*) had been injured by the hoes and small areas of these roots had become slightly invaded by wound fungi (unidentified). When *Armillaria* subsequently invaded the roots, it formed a zone-line around the affected wound area, isolating but never penetrating it (Pl. XII, fig. 2).

An experiment was carried out to test the application of this antagonism between *Armillaria* and other fungi, as a practical measure on tea estates. When I was questioned about the burying of thick woody prunings I had to state that they might become invaded by *Armillaria* should that fungus be already present in the soil. A set of woody prunings was left on top of the soil for a month to be invaded by various saprophytes. These dead prunings were then buried in the soil alongside a set of fresh woody prunings, roots of *Gliricidia sepium* infected with *Armillaria* being placed in contact with the two sets of prunings as a source of infection.

After burial for a month the fresh prunings were heavily infected by *Armillaria* while the dead prunings were quite free and, what is more, had been hollowed out by termites. The experiment was repeated in the laboratory in order to eliminate the part played by termites and again *Armillaria* failed to attack the dead prunings. From these results it would seem advisable for planters to leave their heavier prunings above ground for at least a month if they do not wish to go to the expense of removing them altogether. It is of interest to note that termites never devour roots infested by *Armillaria*.

Campbell (1934) has shown that a medium rich in carbohydrates is necessary for the production of rhizomorphs, and this is also well

shown in Pl. XIII, fig. 1. A sawdust extract was obtained from a root of a "Muula" tree which was depleted of starch by ring-barking but which had not died. Varying amounts of glucose were added to the extract and agar cultures were made in flasks. The development of rhizomorphs was clearly related to the concentration of glucose (Pl. XII, fig. 1). Increasing the percentage of glucose increased the number of rhizomorphs.

Test-tube cultures of *Armillaria* on blocks of "Muula" root (with bark adhering) showed that numerous dark brown strands of xylostroma break through the bark of sterilized healthy roots whereas the xylostroma fails to break through the bark of sterilized roots taken from trees ring-barked a year previously. This reduction in the development of xylostroma sometimes occurs naturally in a lateral root of a tea bush infected with *Armillaria*.

These observations indicate that ring-barking would diminish the infectivity of the roots of a tree which were attacked by *Armillaria* after ringing since the penetration of the strands of xylostroma through the bark and the development of rhizomorphs would be curtailed.

Practical aspect of biologic control

Difficulty may be experienced in ring-barking trees which readily regenerate their bark, because it is then necessary to cut a little way into the sapwood. If the cut is made too deep, the tree dies back rapidly down to the ring, the effect being the same as felling; if the cut is not deep enough there is regeneration of bark. This occurred on some *Grevillea* planted as shade trees on an estate in a heavily infected tea garden. *Armillaria* became established in the roots of some of these exotic trees after ringing, indicating that ring-barking may break down natural resistance in *exotic* trees although not affecting that of *indigenous* trees described later in this paper.

In order to cause depletion of the roots in the shortest possible time by ring-barking, it is important to decide on the best season in which to ring trees. Evergreens present the greatest difficulty; deciduous trees are probably depleted most rapidly if they are ringed just after they have broken into leaf.

In dealing with trees which die slowly after ring-barking, it may be safe to fell them one year after ringing because the roots would probably then be so depleted of carbohydrates that they would die more rapidly after felling than if they were left to die after ring-barking alone. The modern method of pulling trees down with a monkey-winch, wrenches the roots even if it does not extricate them all, and they probably die more quickly after this method of clearing than when the trees are felled. All sucker growth on the

trunk below the ring and from the surface roots should be rigorously suppressed.

These practical matters designed to hasten the death of the roots all need careful consideration if ring-barking is to be made a successful method of control.

Susceptibility of indigenous trees

In Nyasaland it is assumed that *Armillaria* is present in the roots of a few isolated stumps remaining in the forests from trees cut down by timber-seeking natives, because standing trees are very rarely found killed by the fungus. If, therefore, there are a few stumps which act as centres of infection when a forest is cleared for a plantation crop, it is necessary to consider the spread of *Armillaria* in both mixed and pure stand forests.

It is generally thought that certain trees are more dangerous than others as potential sources of infection in Nyasaland, notably "Muula" (*Parinari mobola*), "Mwanga" (*Afrormosia angolensis*), "Kamponi" (*Brachystegia appendiculata*) and "Mkalati" (*Burkea africana*). Roots of other trees infected with *Armillaria* have been found associated with the roots of dead tea bushes, but most species are not considered liable to invasion by this fungus.

An experiment was designed to investigate the relative susceptibility of felled and standing indigenous trees. Inoculations were made on the roots of twenty-six species of trees commonly found in the mixed forests of the tea areas of Nyasaland. Lateral roots ($\frac{1}{2}$–$1\frac{1}{2}$ in. diam.) were chosen, marked by stakes and then re-covered with soil a month before the inoculations were made, to ensure the healing of minor wounds inflicted during the search for the roots.

In order to simulate the effect of felling, the lateral roots were sawn through, at a distance of 4 ft. from the trunk, at the time of inoculation. Two trees of each species were tested for resistance to attack by *Armillaria* by placing the inoculum (portions of infected roots of *Glyricidia sepium*) in contact with their roots. Six roots of each tree were inoculated, three being cut through above the point of inoculation and three being left uncut. The inoculations were made in February 1937 and the roots were examined four months later.

It was noticed that the inoculations had caused two types of infection:

(*a*) Infection occurred, but *Armillaria* was confined to a small localized lesion by the formation of a gum barrier in the wood and callus development in the bark. Pl. XIII, fig. 2 (to which reference is made later in this paper) shows this form of resistance occurring naturally in the root of an indigenous tree ("Msopa", *Bridelia micrantha*).

(*b*) Infection was followed by active parasitism by *Armillaria* without any evidence of resistance.

Table I

Indigenous trees		No. roots inoculated = 12			
		No. roots cut = 6		No. roots uncut = 6	
Vernacular name	Botanical name	Roots invaded	Roots invaded but resistant	Roots invaded	Roots invaded but resistant
1. Mwanga	*Afrormosia angolensis*	3	0	0	0
2. Ntangatanga	*Albizzia versicolor*	2	0	0	0
3. Chidiapumbwa	*Antidesma venosum*	1	0	0	0
4. Nakuyu	*Ficus capensis*	1	0	0	0
5. Mutundu	*Ficus mallotacarpa*	0	0	0	0
6. Mbilima	*Canthium crassum*	0	0	0	0
7. Mlombwa	*Pterocarpus angolensis*	4	0	4	4
8. Mkalati	*Burkea africana*	4	0	2	2
9. Kamponi	*Brachystegia appendiculata*	3	0	2	2
10. Msuku	*Uapaca Kirkiana*	3	0	2	1
11. Msopa	*Bridelia micrantha*	4	0	2	2
12. Zidyatungu	*Lannea* (? *L. Schimperi*)	5	0	2	2
13. Mbuluni	*Harungana madagascariensis*	4	0	1	0
14. Chinuni	*Maesa* (? *lanceolata*)	2	0	3	3
15. Jika	*Pseudalachnostylis* sp.	5	0	2	2
16. Bwabwa	(Not identified)	4	0	1	1
17. Mpefu	*Trema guiniensis*	3	0	1	1
18. Kasokolowe	*Uapaca nitida*	3	0	4	2
19. Nanyole	*Olima cymosa*	2	1	1	1
20. Chikwani	*Albizzia sassa*	5	1	3	3
21. Chilimbu	*Faurea saligna*	6	2	3	3
22. Zinyambazo	*Dalbergia nitidula*	1	1	1	0
23. Kabini	*Combretum Gueinzii*	5	2	2	2
24. Chisungwa	(Not identified)	2	2	1	1
25 Tsamba	*Brachystegia floribunda*	4	0	2	2
26. Mombo	*Brachystegia longifolia*	6	0	4	4

The table shows the distribution of these two types of infection in the cut and uncut roots of the twenty-six species of trees tested for susceptibility to *Armillaria*. It suggests the following conclusions:

A. *Uncut roots*. Species 1 to 6 were never invaded by *Armillaria* and appear to be completely resistant to attack. All the other species were invaded by the fungus but were able, except species 13 and 22, to confine the parasite within narrow limits by the formation of gum barriers and callus.

B. *Cut roots*. All species, except 5 and 6, were susceptible to invasion by *Armillaria* and all were incapable of preventing the fungus travelling freely down the root, although species 19 to 24 resisted in some of their roots.

This experiment gave the surprising result that almost every species of tree found in the tea districts was a potential host for *Armillaria*. The interesting question why some only of these species

are generally considered to be dangerous as sources of infection by *Armillaria* is discussed later in connexion with the ecology of this fungus.

The resistance shown by the uncut roots in this experiment resembles that in the Myrobalan plum (*Prunus cerasifera*) described by Thomas (1934), but he makes no reference to the formation of gum. He states that a careful examination of the lesions indicated that the fungus was extending only very slowly in the roots, and probably not at all in some of them. The lesions were bordered by tissue which was bright red and extremely hard and brittle. If, as Thomas suggests, the fungus was extending very slowly in the roots, it is very possible that when the roots are severed the fungus can become dominant and travel freely in the roots. An experiment was carried out to examine this possibility. A healthy "Msopa" tree (*Bridelia micrantha*) was found amongst a group of "Muula" stumps, the roots of which were known to be infected by *Armillaria*. It was found that whenever the healthy "Msopa" root was in contact with a diseased "Muula" root, *Armillaria* had invaded the former and caused a localized lesion (Pl. XIII, fig. 2). These were similar to those described by Thomas for the fungus was often equally strongly developed in the wood and in the cortex, whereas, in a susceptible host, the fungus normally grows much more rapidly in the cortex and cambium than in the wood.

Six roots of the "Msopa" tree were cut through above a lesion and six were ring-barked above a lesion in January 1938. All the roots were re-covered with soil after treatment. An examination of two cut and two ringed roots showed that there was no evidence, after two months, that the resistance of the lesions had broken down. Mr A. P. S. Forbes, Agricultural Officer, Department of Agriculture, Nyasaland examined the remainder of the roots in December 1938 and reported:

A. *Roots ringed. Armillaria* absent in all. In every specimen but one, regeneration of the removed tissues had taken place. Where no regeneration, invasion by a fungus resembling *Botryodiplodia Theobromae*.

B. *Roots cut through.* In all material examined, *Armillaria* growing freely. Roots infected were excavated to at least 6 ft. of their length and cut longitudinally. Indication that the focus of the invasion was from the point of contact with the "Muula" roots but *not* definite.

This experiment, apart from favouring the hypothesis of control by ring-barking, indicates that trees growing near dead stumps in forests may have many localized lesions of *Armillaria* dormant in their roots and that the fungus in these lesions may become active when the forest is felled for a plantation crop. The fungus may spread from these localized lesions even though the roots of the original dead

stumps may have been rotted by *Armillaria* beyond the stage in which they would be capable of causing infection.

Some roots on the "Msopa" tree already mentioned had been invaded at two points close together but on opposite sides. Such roots had lost the power of resistance below the points of infection, *Armillaria* having travelled freely down the root but not up to the crown.

In Nyasaland *Eucalyptus* trees are not considered susceptible to *Armillaria*, this being one reason why they are frequently planted for firewood. Observations showed that a *Eucalyptus* tree forms localized lesions when invaded by *Armillaria* similar to those described for the "Msopa" tree. If the *Eucalyptus* tree, however, is situated on ground containing a mass of diseased "Muula" roots it sometimes succumbs to *Armillaria* root disease, its resistance being undoubtedly lowered by the large number of invasions made throughout its root system.

The observations and experiments just described throw further light on the reasons for the sudden and rapid spread of *Armillaria* in newly cleared forests.

Ecology of *Armillaria*

The results obtained in the experiment on the susceptibility of indigenous trees, showing that nearly all species in a mixed forest are susceptible to *Armillaria* after the roots are severed, raises the critical question why a few only of these species are usually associated with this fungus as a source of infection in tea estates. I suggest that many trees escape infection because their roots die rapidly after felling before *Armillaria* reaches them. Once dead, and invaded by saprophytes, these quick-dying roots cannot be attacked by *Armillaria*. Unless, therefore, roots of one of the quick-dying species are in close contact with a centre of infection at the time of clearing a mixed forest, they are unlikely to become infected before they die. These *dead* roots of the quick-dying trees probably form a barrier region in the soil through which *Armillaria* is unable to extend should it approach along the *moribund* roots of the slow-dying trees. This suggests why *Armillaria* root disease so often occurs in small isolated patches of tea planted on the site of a mixed forest.

The species of tree considered most dangerous as sources of infection by *Armillaria* are those of which the roots die very slowly after felling. In January 1938 a root of "Mwanga" (*Afrormosia*) was found alive at a depth of 3 ft. in a block of tea planted in 1934. "Muula" (*Parinari mobola*) is another such tree; in some regions it forms pure stand forests containing, to the acre, as many as five hundred 30 ft. high trees characterized by extensive horizontal lateral roots as well as firm tap roots. The ability of the roots of "Muula" to keep alive

so long after felling probably explains why a pure stand forest of "Muula" trees often gives rise later to such widespread damage in tea gardens, because starting from a few scattered infected stumps, as in the mixed forest, *Armillaria* can spread unimpeded along a network of *moribund*, but still susceptible, roots.

The fructifications of *Armillaria* are often present on dead "Muula" stumps during the wet season in Nyasaland, although they are not always easily found, as they deliquesce rapidly on reaching maturity. All attempts at inoculating stumps and roots of trees in various ways with suspensions of basidiospores were unsuccessful. Even if the matters discussed in this paper help to explain outbreaks of *Armillaria* root disease, it still remains to be shown if spores play any part in originating centres of infection in standing or felled forests. The solution of this question is of fundamental importance in the study of *Armillaria* in order to explain how isolated stumps become infected in a virgin forest.

Summary

1. Problems of controlling *Armillaria* root disease in young and old plantation crops are discussed with special reference to tea estates in Nyasaland.

2. A method is suggested for curtailing the normal course of the disease in young plantations.

3. The basic means of control is by preventing the infection of the remaining roots of forest tree roots after the land is cleared. Ring-barking is still considered to be the best method of biologic control. Observations and experiments are described upholding this conclusion.

4. The ecology of *Armillaria mellea* is discussed. An experiment showed that nearly all the indigenous trees can be invaded by the fungus though the roots of a few species only are commonly associated with *Armillaria* root disease of tea. The roots of most species can normally localize the infection but when the roots are severed the fungus travels freely.

5. The rate at which tree roots die after felling is thought to be the factor which controls the distribution of *Armillaria* in cleared forests. Roots which die quickly and become invaded by saprophytes are considered to restrict the spread of *Armillaria*, while roots which die slowly facilitate the spread of that fungus.

6. Further work is needed on the part played (if any) by spores, in starting centres of infection in virgin forest.

Acknowledgements

In conclusion I am greatly indebted to Mr A. P. S. Forbes, Agricultural Officer, Department of Agriculture, Nyasaland, for concluding an experiment which I had started and for sending me

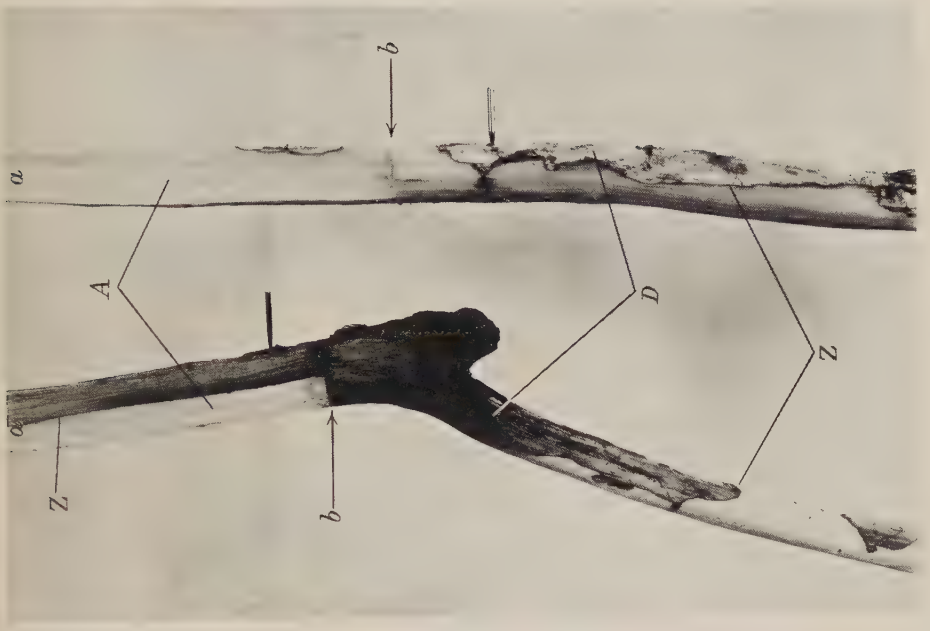

Fig. 2.

Fig. 1.

the result. I wish to express my appreciation to the Managers of Ruo Estates Ltd., J. Lyons and Co., Ltd. and the Nyasa Tea Estates Ltd. for many facilities afforded in connexion with this work, and also to Mr P. Topham of the Forestry Department, Nyasaland, for identifying various indigenous trees.

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EXPLANATION OF PLATES XII AND XIII

Plate XII

Fig. 1. Tea root cut longitudinally. *A*, portion rotted by *Armillaria*; *D*, dry-rotted portion; *Z*, zone-line. × ¾.
Fig. 2. Two "Muula" (*Parinari mobola*) roots. *a*, half cut away longitudinally as far as *b*; *A*, portion rotted by *Armillaria*; *Z*, zone-line; *D*, dry-rotted portion. × ½.

Plate XIII

Fig. 1. Rhizomorph development in saw-dust extract agar; cultures from roots of ring-barked "Muula" tree. 0, 0·25, 0·5, 1·0, 2·0 and 4·0 per cent glucose added. × ½.
Fig. 2. "Msopa" (*Bridelia micrantha*) roots, cut transversely at point of contact with infected "Muula" roots (removed), showing invasion by *Armillaria* confined to localized lesions. *c*, callus; *A*, *Armillaria* in wood; *g*, gum barrier; *x*, xylostroma. × ¾.

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PROCEEDINGS

Meeting held at University College, London, 25 March 1939.

The President, E. W. Mason, Esq., M.A., M.Sc., in the Chair.

P. K. Frazer. Some figures on the incidence of superficial mycoses.

P. H. Gregory. Some forms of *Ramularia vallisumbrosae* Cav. on *Narcissus*.

R. Leach. The problem of controlling *Armillaria* root disease in Nyasaland.

A. F. Parker-Rhodes. Investigations on certain substances obtained from the wheat plant toxic to rust uredospores.

Miss K. Sampson. *Olpidium Brassicae* (Wor.) Dang. and its connection with *Asterocystis radicis* De Wild.

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63. Ciferri, Professor Dr R., Assistant Director, Laboratorio Crittogamico, Casella Postale 165, Pavia, Italy. (1926.)
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65. Cleland, Mr J. Burton, M.D., Professor of Pathology, University of Adelaide, South Australia. (1918.)
66. Clouston, Mr D., M.A., B.Sc., (Agr.), North of Scotland College of Agriculture, Crown Mansions, 41 Union Street (2nd Floor), Aberdeen. (1931.)
67. Colson, Miss B., B.Sc., Ph.D., The University, Manchester. (1934.)
68. Connecticut Agricultural Experiment Station, New Haven, Connecticut, U.S.A. (1929.)
69. Cook, Mr W. R. I., B.Sc., Ph.D., Department of Botany, University College, Newport Road, Cardiff. (1924.)
70. Cooke, Mr G. J., 143 Newmarket Road, Norwich. (1933.)
71. Cooke, Mrs G. J., 143 Newmarket Road, Norwich. (1937.)
72. Cooper, Miss Charlotte A., California Lane, Bushey Heath, Herts. (1911.)
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74. Cornell University, The Library, New York State College of Agriculture, Ithaca, N.Y., U.S.A. (1920.)
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112. Fitzpatrick, Professor H. M., Ph.D., 220 Bryant Avenue, Ithaca, New York, U.S.A. (1935.)
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130. Gregory, Mr P. H., Ph.D., Seale Hayne Agricultural College, Newton Abbot, Devon. (1930.)
131 Grieve, Mr B. J., M.Sc., Ph.D., Botanical Department, Melbourne University, Carlton, Victoria, Australia. (1931.)
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134. Hanna, Mr W. F., M.Sc., Ph.D., Dominion Rust Research Laboratory, Agricultural College, Winnipeg, Canada. (1925.)

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137. Harris, Mr G. C. M., 148 Divinity Road, Oxford. (1934.)
138. Harris, Mr R. V., B.Sc., A.R.C.S., Horticultural Research Station, East Malling, Kent. (1924.)
139. Harrison, Mr T. H., D.Sc., Australia House, Strand, London, W.C. 2. (1931.)
140. Harvard University, The Library, Cambridge, Mass., U.S.A. (1923.)
141. Hastings, Mr Somerville, M.S., F.R.C.S., 43 Devonshire Street, Portland Place, London, W. 1. (1913.)
142. Hawker, Miss L. E., Ph.D., Botanical Department, Imperial College of Science, London, S.W. 7. (1934.)
143. Heim, M. Roger, Sous-Directeur au Muséum d'Histoire Naturelle, 11 Rue de Médicis, Paris (6^{e}), France. (1930.)
144. Heimbeck, Mrs Louise, Brosoe, Levanger, Norway. (1923.)
145. Hemmi, Dr Takewo, Phytopathological Institute, Department of Agriculture, Kyoto Imperial University, Kyoto, Japan. (1923.)
146. Hereford, Mr E. H., 131 Queen Victoria Street, London, E.C. 4 (1933.)
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150. Honolulu, Association of Hawaiian Pineapple Canners, P.O. Box 3166, Hawaii. (1929.)
151. Honolulu, The Library, Experimental Station, S.P.A., Box 411, Hawaii. (1920.)
152. Horne, Mr A. S., D.Sc., F.L.S., F.G.S., Botanical Department, Imperial College of Science, South Kensington, London, S.W. 7. (1921.)
153. Howard, Mr H. J., F.R.M.S., F.L.S., "Lingfield", 6 College Road, Norwich. (1918.)
154. Hubbard, Miss M. D., B.Sc., Laren, Western Drive, Littleover, Derby. (1933.)
155. Hughes, Mr G. C., Priory Road, Bicester. (1898.)
156. Hughes, Mr J. S., M.A., University Observatory, Oxford. (1927.)
157. Hull, The Librarian, Botanical Department, University College. (1929.)

158. Humphrey, Dr C. J., 543 No. La Cienega Blvd., Los Angeles, California. (1921.)
159. Hurst, Mr C. P., F.L.S., Landulph Rectory, Saltash, Cornwall. (1928.)
160. Ingold, Mr C. T., M.Sc., Ph.D., Department of Botany, University College, Leicester. (1935.)
161. Iowa, The Library, State University of Iowa, Library Annex, Iowa City, U.S.A. (1923.)
162. Iowa State College, Library, Ames, Iowa, U.S.A. (1927.)
163. Issatchenko, Professor Dr B. L., Nowinskii B. 25, log. 11, Moscow 69, U.S.S.R. (1923.)
164. John Crerar Library, 86 East Randolph Street, Chicago, Illinois, U.S.A. (1929.)
165. Johnson, Mr J. W. Haigh, M.Sc., F.I.C., F.L.S., Walton, nr. Wakefield. (1919.)
166. Johnstone, Mr R. H., 726 Anniesland Road, Glasgow, W. 4. (1938.)
167. Jones, Mr G. H., M.A., Kasenga, Stanley Avenue, Chesham. (1922.)
168. Jørstad, Mr Ivar, Statsmykolog, Botanisk Museum, Oslo, Norway. (1923.)
169. Keay, Miss M. A., M.A., Ph.D., Department of Agricultural Botany, The University, Reading. (1935.)
170. Keissler, Dr Karl, Direktor d. Botanischen Abteilung, Naturhistorisches Museum, Burgring 7, Wein 1/1, Austria. (1924.)
171. Kelly, Dr Howard A., 1418 Eutaw Place, Baltimore, Md., U.S.A. (1921.)
172. King, Miss M. E., B.A., Research Station, East Malling, Kent. (1935.)
173. Klika, Mr Bohumil, Hálkova, 37 Prague, Vrsovice 553 Czechoslovakia. (1926.)
174. Knight, Mr H. H., M.A., The Lodge, All Saints' Villas, Cheltenham. (1914.)
175. Kuala Lumpur, F.M.S., The Director of Agriculture, Straits Settlements, and Federated Malay States. (1930.)
176. Lamb, Mr I. M., British Museum (Natural History), London, S.W. 7. (1934.)
177. Leach, Mr R., B.A., Assistant Advisory Mycologist, School of Agriculture, Cambridge. (1929.)
178. Leicester, The Museum, City of Leicester. (1923.)
179. Likhite, Dr Y. N., Department of Agriculture, Baroda State, India. (1936.)
180. Linder, Dr D., Farlow Herbarium, Harvard University, 20 Divinity Avenue, Cambridge, Mass., U.S.A. (1935.)

181. Line, Mr James, M.A., School of Agriculture, Cambridge. (1921.)
182. Linnean Society, The, Burlington House, Piccadilly, London, W. 1. (1919.)
183. Lloyd Library, The, 309 West Court Street, Cincinnati, Ohio, U.S.A. (1907.)
184. Loader, Miss F. M., B.Sc., Botanical Department, University College, Southampton. (1927.)
185. Lütjeharms, Professor W. J., Phil.Nat.D., Department of Botany, University College, Bloemfontein, Orange Free State, S. Africa. (1930.)
186. Macdonald, Dr James A., Botany Department, The University, St Andrews. (1938.)
187. McKay, Mr Robert, B.Sc., A.R.C.S.I., Department of Plant Pathology, Albert Agricultural College, Glasnevin, Dublin. (1939.)
188. McLennan, Dr Ethel I., Botanical Department, Melbourne University, Carlton, Victoria, Australia. (1926.)
189. Madras University Library, Senate House, Triplicane, Madras, South India. (1925.)
190. Maire, M. René, D.Sc., F.M.L.S., Professeur à la Faculté des Sciences de l'Université, Algiers, Algeria, N. Africa. (1907.)
191. Marsh, Mr R. W., M.A., Research Station, Long Ashton, Bristol. (1923.)
192. Masefield, Mr G. B., c/o Department of Agriculture, Entebbe, Uganda. (1932.)
193. Mason, Mr E. W., M.A., M.Sc., F.L.S., Imperial Mycological Institute, Ferry Lane, Kew, Surrey. (1921.)
194. Mason, Mrs E. W., M.Sc., Inglenook, 63 King's Road, Richmond, Surrey. (1922.)
195. Matthews, Professor J. R., M.A., F.L.S., Department of Botany, The University, Old Aberdeen. (1921.)
196. Mathias, Mr W. T., B.Sc., The University, Liverpool. (1938).
197. Mehta, Professor K. C., Ph.D., Department of Biology, Agra College, Agra, U.P., India. (1921.)
198. Metcalfe, Mr C. R., B.A., Ph.D., Jodrell Laboratory, Royal Botanic Gardens, Kew, Surrey. (1926.)
199. Michigan Agricultural College Library, East Lansing, Michigan, U.S.A. (1924.)
200. Miller, Professor J. H., B.S., M.S., Ph.D., University of Georgia, Athens, Ga., U.S.A. (1930.)
201. Millidge, Mr P. H., 205 Carisbrooke Road, Newport, I.O.W. (1937.)
202. Missouri, The Botanical Garden, St Louis, Mo., U.S.A. (1902.)

203. Mitra, Mr M., M.Sc., Ph.D., D.I.C., Assistant Mycologist, Imperial Institute of Agricultural Research, Delhi, India. (1928.)
204. Miyabe, Dr Kingo, Professor Emeritus of Botany, Hokkaido Imperial University, Sapporo, Japan. (1919.)
205. Montague, Mrs A., Penton, Crediton, N. Devon. (1898.)
206. Montreal, Institut Botanique de l'Université, 4101 Est, Rue Sherbrooke, Canada. (1932.)
207. Moore, Mr W. C., M.A., Ministry of Agriculture, Pathological Laboratory, Milton Road, Harpenden, Herts. (1922.)
208. Morgan, Dr G., Ashley-Hatton, Dyke Road Avenue, Brighton. (1928.)
209. Morris, Mr L. E., c/o Eton College, Windsor, Berks. (1924.)
210. Mostafa, Mr M. A. A., The Botany School, Cambridge. (1938.)
211. Muller, Dr H. R. A., c/o "Internatio", Semarang, Java. (1932.)
212. Murray, Mr G. H., F.E.S., Director of Agriculture, Rabaul, New Britain, Territory of New Guinea, via Australia. (1921.)
213. Muskett, Mr A. E., M.Sc., A.R.C.S., Queen's University, Belfast, Northern Ireland. (1923.)
214. Nannfeldt, Prof. J. A., Sturegatan 11, Uppsala, Sweden. (1932.)
215. National Collection of Type Cultures, Curator, Lister Institute, Chelsea Gardens, London, S.W. 1. (1921.)
216. National Museum of Wales, Cardiff. (1924.)
217. Nash-Wortham, Mr J. R. H., Abingdon, Gatesden Road, Fetcham, Leatherhead, Surrey.
218. Nattrass, Mr R. M., B.Sc. (Agric.), Ph.D., Department of Agriculture, P.O.B. 338, Nairobi, Kenya. (1925.)
219. Nederlandsche Mycologische Vereeniging, The Librarian, Zoornweg 10, Wageningen, Holland. (1920.)
220. Newcastle-on-Tyne, The Librarian, King's College. (1928.)
221. New York Botanical Garden, Bronx Park, New York, U.S.A. (1904.)
222. Noel, Miss E. F., F.L.S., 37 Burnham Court, Queen's Road, London, W. 2. (1913.)
223. North Carolina, Library, University of, Chapel Hill, North Carolina, U.S.A. (1920.)
224. Nursery and Market Garden Industries' Development Society, Ltd., Experimental and Research Station, Cheshunt, Herts. (1922.)
225. O'Connor, Mr P., Ph.D., B.Sc., A.R.C.Sc.I., National Museum, Dublin. (1925.)
226. Ogilvie, Mr L., M.A., M.Sc., Research Station, Long Ashton, nr. Bristol. (1922.)
227. Oke, Mr Alfred William, B.A., F.G.S., F.L.S., 32 Denmark Road, Hove, Sussex. (1908.)

228. Ontario Agricultural College, Library, Guelph, Ontario, Canada. (1920.)
229. Osborn, Professor T. G. B., D.Sc., F.L.S., Botanical Department, The University, Oxford. (1910.)
230. Oyler, Miss E., Experimental and Research Station, Cheshunt, Herts. (1937.)
231. Padwick, Dr G. Watts, Imperial Agricultural Research Institute, New Delhi, India. (1936.)
232. Page, Miss W. M., M.Sc., Ph.D., 5 Dartmouth Chambers, Theobalds Road, London, W.C. 1. (1921.)
233. Parke Davis and Co., Medical Research Library, P.O. Box 488, Detroit, Michigan, U.S.A. (1920.)
234. Parker, Professor C. S., Department of Botany, Howard University, Washington, D.C., U.S.A. (1932.)
235. Parker-Rhodes, Mr A. F., The Research Station, Long Ashton, Bristol. (1938.)
236. Patrick, Miss S. H. M., Elmsleigh House, Stoughton Avenue, Leicester. (1937.)
237. Pearson, Mr Arthur A., F.L.S., Nutcombe House, Haslemere Road, Hindhead, Surrey. (1911.)
238. Peklo, Dr Jaroslav, Professor of Applied Botany, Bohemian Technical University, Charles Square, Prague II, Czechoslovakia. (1924.)
239. Pershouse, Mrs Stanley, Denhem Lodge, Yelverton, S. Devon. (1937.)
240. Perthshire Society of Natural Science, c/o J. F. Cumming, Esq., 12 Barossa Place, Perth. (1919.)
241. Petch, Mr T., B.A., B.Sc., North Wootton, King's Lynn, Norfolk. (1911.)
242. Pethybridge, Mr G. H., O.B.E., Ph.D., B.Sc., F.L.S., 41 Moreton End Lane, Harpenden. (1919.)
243. Peyronel, Dr Benjamino, R. Istituto Sup. Agrario e Forestale, Piazzale del Re, Firenze, Italy. (1932.)
244. Philadelphia, The Academy of Natural Sciences of Philadelphia, Nineteenth and The Parkway, Phil., U.S.A. (1925.)
245. Phillips, Dr H. H., 6 St John's Road, Penge, London, S.E. 10. (1923.)
246. Ping, Mr A. Wentworth, M.A., "St Olave's", Clifton, York. (1926.)
247. Pollard, Mr S. C., c/o The Defence Department, The Secretariat, Rangoon, Burma. (1937.)
248. Potter, Rev. M. C., Sc.D., M.A., F.L.S., Corley Croft, New Milton, Hants. (1896.)
249. Preston, Mr N. C., B.Sc., Harper Adams Agricultural College, Newport, Salop. (1920.)

250. Pretoria, South Africa, The Chief, Division of Plant Industry (91403), Department of Agriculture. (1922.)
251. Purdue University, Library, Agricultural Experiment Station, Lafayette, Ind., U.S.A. (1931.)
252. Ramsbottom, Mr J., O.B.E., Dr.Sc., M.A., Pres.L.S., British Museum, (Nat. Hist.), Cromwell Road, South Kensington, London, S.W. 7. (1910.)
253. Ray, Miss Anne, Penarwyn, Gorran Haven, Gorran, Cornwall. (1929.)
254. Rayner, Dr M. Cheveley (Mrs Neilson Jones), Bedford College for Women, Regent's Park, London, N.W. 1. (1921.)
255. Rea, Miss M. W., M.Sc., Salem House, Sydenham, Belfast, Northern Ireland. (1920.)
256. Rees, Mr John, M.Sc., Adviser in Agricultural Botany, University College, Cardiff. (1929.)
257. Reichert, Dr Israel, Jewish Agency for Palestine, Agricultural Experiment Station, P.O.B., 15 Rehoboth, Palestine. (1924.)
258. Rhodes, Miss Mabel, Lister Institute, Chelsea Gardens, London, S.W. 1. (1921.)
259. Robinson, Mr E., 26 Burwood Avenue, Eastcote, Pinner, Middlesex. (1938.)
260. Rothamsted Experimental Station, Department of Mycology, Harpenden, Herts. (1923.)
261. Rutgers College and State University of New Jersey, Library, New Brunswick, New Jersey, U.S.A. (1922.)
262. St Paul, Minnesota, U.W.A., The Library, Department of Agriculture University Farm. (1920.)
263. Salmon, Professor E. S., F.L.S., South-Eastern Agricultural College, Wye, Kent. (1922.)
264. Sampson, Miss K., M.Sc., University College, Aberystwyth, North Wales. (1920.)
265. Samuel, Mr Geoffrey, M.Sc., Ministry of Agriculture, Pathological Laboratory, Milton Road, Harpenden, Herts. (1923.)
266. Scott, Mr W. W., 13 Bishop's Road, Highgate, London, N. 6. (1922.)
267. Searle, Mr G. Odell, B.Sc. (Agric.), Flax Research Institute, Flitcham Abbey, nr. King's Lynn, Norfolk. (1920.)
268. Seth, Mr N. L., B.Sc., Ph.D., D.I.C., Agricultural College, Mandalay, Burma. (1930.)
269. Shear, Dr C. L., U.S. Department of Agriculture, Bureau of Plant Industry, Washington, D.C., U.S.A. (1930.)
270. Skene, Professor Macgregor, Department of Botany, The University, Bristol. (1936.)

271. Smith, Mr Alexander, M.A., Ph.D., Ministry of Agriculture, Pathological Laboratory, Milton Road, Harpenden, Herts. (1924.)
272. Smith, Mr G., London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C. 1. (1936.)
273. Smith, Professor Noel J. G., Ph.D., B.Sc., Botany Department, Rhodes University College, Grahamstown, S. Africa. (1924).
274. Smith, Mr Rupert, 38 Greenhill Gardens, Edinburgh. (1927.)
275. South London Botanical Institute, 323 Norwood Road, Tulse Hill, London, S.E. 24. (1921.)
276. Stakman, Professor E. C., University of Minnesota, Department of Agriculture, University Farm, St Paul, Minn., U.S.A. (1922.)
277. Statham, Miss E. M., 2 Westbrook Road, Blackheath, London, S.E. 3. (1926.)
278. Stationery Office, H.M., Superintendent of Publications, Book Dept., Westminster, S.W. 1. (4 subscriptions.) (1920.)
279. Stephens, Miss E. L., B.A., Department of Botany, University of Cape Town, South Africa. (1928.)
280. Stephens, Miss F. L., M.Sc., Department of Botany, British Museum (Natural History), Cromwell Road, South Kensington, London, S.W. 7. (1930.)
281. Steven, Mr W. F., 8 Dynevor Road, Richmond, Surrey. (1937.)
282. Stevenson, Dr J. A., U.S. Department of Agriculture, Bureau of Plant Industry, Washington, D.C. (1937.)
283. Steyaert, M. R. L., Ing. A.I.Gx., Laboratoire Bambesa, Uele, Belgian Congo. (1931.)
284. Stiles, Professor W., Sc.D., F.R.S., Department of Botany, The University, Edgbaston, Birmingham. (1936.)
285. Stirrup, Mr H. H., M.Sc., Midland Agricultural College, Sutton Bonnington, Loughborough. (1922.)
286. Storey, Mr H. H., M.A., Ph.D., East African Agricultural Research Institute, Amani, Tanganyika Territory, East Africa. (1922.)
287. Sutherland, Mr G. K., M.A., D.Sc., F.L.S., The Moorings, Rosemary Hill, Streetly, Sutton Coldfield, Birmingham. (1914.)
288. Swanton, Mr E. W., M.B.E., A.L.S., Educational Museum, Haslemere, Surrey. (1899.)
289. Swedish Academy of Sciences, Royal, Stockholm, Sweden. (1919.)
290. Sydney, Australia, The Librarian, University of. (1922.)
291. Sydow, Herr H., Luitpoldstrasse 33, Berlin, W. 30, Germany. (1931.)

292. Tabor, Mr R. J., B.Sc., F.L.S., Botanical Department, Imperial College of Science, South Kensington, London, S.W. 7. (1914.)
293. Tennessee, University of, Agricultural Experiment Station, Library, Knoxville, Tennessee, U.S.A. (1926.)
294. Tervet, Mr I. W., B.Sc., Department of Plant Pathology, University Farm, St. Paul, Minn. U.S.A. (1933.)
295. Tetley, Miss U., Quarry Garth, Windermere, Westmorland. (1929.)
296. Tomkins, Mr R. G., M.A., Ph.D., Trinity College, Cambridge. (1925.)
297. Topping, Mrs M. P., 3 Southdown Crescent, Cheadle Hulme, Cheshire. (1930.)
298. Toro, Professor R. A., College of Agriculture, Mayaguez, Porto Rico. (1937.)
299. Tunstall, Mr A. C., Tocklai Experimental Station, Cinnamara, P.O., Assam, British India. (1933.)
300. Vanterpool, Mr T. C., M.Sc., Botanical Department, University of Saskatchewan, Saskatoon, Canada. (1929.)
301. Venkatarayan, Mr S. V., Senior Assistant Mycologist, Agricultural Department, Bangalore, S. India. (1935.)
302. Wadham, Professor S. M., M.A., Department of Agriculture, The University, Melbourne, Victoria, Australia. (1922.)
303. Wakefield, Miss E. M., M.A., F.L.S., Herbarium, Royal Botanic Gardens, Kew. (1911.)
304. Waldie, Mr J. S. L., B.Sc., C.D.A., Department of Agricultural Botany, The University, Reading. (1925.)
305. Wales, University College of, Librarian, Botanical Department, Aberystwyth, North Wales. (1927.)
306. Walker, Miss M. M., B.A., The Horticultural College, Swanley, Kent. (1937.)
307. Wallace, Mr E. R., Agricultural Institute, Kirton, nr. Boston, Lincs. (1934.)
308. Wallace, Mr G. B., B.Sc. (Agric.), Ph.D., Department of Agriculture, Morogoro, Tanganyika Territory, East Africa. (1928.)
309. Wallace, Mrs G. B., B.Sc., Morogoro; Tanganyika Territory, East Africa. (1924.)
310. Wallis, Mr A., Westacre, Station Road, Kettering. (1921.)
311. Ware, Mr W. M., D.Sc., South-Eastern Agricultural College, Wye, Kent. (1924.)
312. Washington, Library, State College of, Pullman, Washington, U.S.A. (1924.)
313. Waterston, Mr J. M., B.Sc., Mycologist, Department of Agriculture, Paget East, Bermuda. (1934.)

314. Watson, Mr W., D.Sc., A.L.S., Cedene, Cheddon Road, Taunton. (1933.)
315. Webb, Dr Phillip, St John's Hospital, Lisle Street, London, W.C. 2. (1938.)
316. Webb, Mr R. A., Keble College, Oxford. (1936.)
317. Westerdijk, Professor Johanna, Javalaan 4, Baarn, Holland. (1923.)
318. Western, Mr J. H., B.Sc., Ph.D., Adviser in Mycology and Agricultural Botany, The University, Manchester, 13. (1934.)
319. Weston, Mr W. A. R. Dillon, M.A., Ph.D., School of Agriculture, Cambridge. (1923.)
320. Whetzel, Professor H. H., M.A., New York State College of Agriculture, Cornell University, Ithaca, N.Y., U.S.A. (1914.)
321. Whitaker, Mr F. Owen, 51 Grosvenor Avenue, Carshalton, Surrey. (1921.)
322. Whitehead, Mr T., D.Sc., A.R.C.S., University College of North Wales, Bangor. (1920.)
323. Wilkins, Mr W. H., M.A., D.Phil., Department of Botany, The University, Oxford. (1928.)
324. Wilkinson, Mr E. H., Research Station, Long Ashton, Bristol. (1938.)
325. Williams, Mr P. H., B.Sc., Experimental and Research Station, Cheshunt, Herts. (1930.)
326. Wilson, Miss A. P., M.B.E., A.R.C.S., "Pencroft", Bingham Road, Radcliffe-on-Trent, Nottingham. (1929.)
327. Wilson, Mr Alastair R., B.Sc., Midland Agricultural College, Sutton Bonnington, Loughborough. (1933.)
328. Wilson, Miss Irene M., B.Sc., Ph.D., Botany Department, University College of Wales, Aberystwyth. (1938.)
329. Wilson, Mr Malcolm, D.Sc., A.R.C.S., F.L.S., Royal Botanic Garden, Edinburgh. (1921.)
330. Wiltshire, Mr S. P., D.Sc., Imperial Mycological Institute, Ferry Lane, Kew, Surrey. (1920.)
331. Wisconsin, The Library, University of, Madison, Wis., U.S.A. (1923.)
332. Wolf, Mr B. L., N.D.A., Cornwall Buildings, 45 Newhall Street, Birmingham. (1923.)
333. Wood, Mr F. C., The Rest, Franklin Road, Durrington, Worthing. (1935.)
334. Woodcock, Mr A. J. A., M.Sc., F.E.S., Rhianva, 65 Rock Avenue, Gillingham, Kent. (1926.)
335. Woodward, Mr R. C., Ph.D., Hawthorndale Laboratories, Agricultural Research Station, Jealott's Hill, nr. Bracknell, Berkshire. (1924.)

336. Woolhope, The Naturalists' Field Club, Hereford. (1896.)
337. Worcestershire Naturalists' Field Club, Hereford. (1921.)
338. Wormald, Mr H., D.Sc., A.R.C.S., Research Station, East Malling, Kent. (1921.)
339. Wyatt-Smith, Mr. J., Wadham College, Oxford. (1938.)
340. Yale University, Library, New Haven, Connecticut, U.S.A. (1930.)
341. Yeoman, Mr J. B., M.D., F.R.S.C., Norton, Wirral, Cheshire. (1934.)
342. Yuill, Mr E., Chingford, Askham Lane, Acomb, York. (1937.)
343. Zundel, Dr G. L. I., Botany Building, Pennsylvania State College, State College, Pa., U.S.A. (1929.)
344. Zürich, Switzerland, Botanical Garden and Museum, c/o Dr A. U. Däniker. (1921.)
345. Zürich, Institut für Spezielle Botanik der Eidg. Techn. Hochschule. (1928.)

Members are requested to report any errors or omissions in the list to Dr C. G. C. Chesters, The University, Birmingham, 15.

RULES

Society's Name and Objects

1. The Society shall be called "The British Mycological Society", and its object shall be the study of Mycology in all its branches.

Members of Society

2. The Society shall consist of Honorary Members, Foundation Members, and Ordinary Members; the number of Honorary Members shall be limited to 20, and that of Foundation Members to 100, but the number of Ordinary Members shall be unlimited.

Honorary Members

3. Honorary Members shall be persons of pre-eminence in Mycology, or who have rendered special service to the Society.

Foundation Members

4. Foundation Members shall be those Members or Societies who joined the Society previous to the limit of 100 Members having been attained.*

Officers

5. The Officers of the Society shall consist of a President, one or more Vice-Presidents, Treasurer, Secretaries and Editor or Editors. They shall be elected annually, at the Annual General Meeting of the Society.

Government of Society

6. The government of the Society shall be vested in a Council, which shall consist of the President and other Officers for the time being, together with nine other Members who shall be elected annually at the General Meeting, three of whom shall be elected to replace three retiring members, who shall not be eligible for immediate re-election. The Members to retire shall be those who have been longest in office, or, in case of equality, shall be determined by ballot. Ex-Presidents who have served their year of office prior to 31st December, 1936, are ex-officio members of the Council. From 1937 the retiring President shall become a Vice-President for a period of two years.

Period of Office

7. The Officers and Council shall hold office as from the 1st of January following their election.

* The limit of 100 Foundation Members was reached 22nd October, 1903.

Plant Pathology Committee

8. The special interests of Plant Pathology shall be delegated to an executive committee, to be called the Plant Pathology Committee of the British Mycological Society. This Committee shall consist of the President and Secretaries *ex-officio* and twelve other members of the Society. The latter shall be elected annually at the Annual General Meeting of the Society, and one-quarter shall retire in rotation each year and shall not be eligible for immediate re-election. The members to retire shall be those who have been longest in office, or, in case of equality, shall be determined by ballot.

The Officers shall consist of a Chairman and a Secretary, to be elected by the Committee each year.

At least two meetings shall be held every year, six members to form a quorum.

The Committee shall have power to appoint for any special purpose a sub-committee consisting either wholly or partly of members of the Committee.

Election of Members

9. Honorary Members shall only be elected at a Meeting of the Society by a majority of the Members then present.

All Ordinary Members shall be proposed and seconded respectively by existing Members, who shall sign a certificate (see Appendix) of recommendation, one at least of the proposers so certifying from personal knowledge. Every candidate for election shall sign an undertaking to abide by the Rules if elected (see Appendix). They shall be elected by a majority of the Members present at any meeting of the Society or by the President and Officers of the Society.

Subscription

10. All Ordinary Members and Societies shall pay an annual subscription of one pound, and Foundation Members five shillings, due on the 1st of January in each year. Honorary Members shall be exempt from any annual subscription.

Any Member wishing to retire from the Society shall give notice to the Hon. Secretary or Treasurer in writing before the 1st of December of the previous year.

Meetings

11. The Society shall hold one or more meetings annually, at a place and time determined by the Members at the preceding Annual General Meeting, or by the Council. The Annual General Meeting, for the election of officers and the transaction of other business, shall coincide with the Autumn Foray.

Accounts

12. At the Annual General Meeting of the Society in each year the Hon. Treasurer shall present duly audited accounts.

Alteration of Rules

13. The Rules shall not be altered except by a two-thirds majority of the Members present at an Annual General Meeting. A printed copy shall be sent to every Member of the Society on election, and in the event of alterations to all Members.

APPENDIX

Form of proposal for Ordinary Membership of the British Mycological Society

.....

of .....

being desirous of becoming an Ordinary Member of the British Mycological Society, we, the undersigned Members of the Society, certify that we consider h to be a desirable Member of the Society, and beg to recommend h for election.

Dated this day of 19

.....(From personal knowledge.)

Certificate to be signed by the Candidate

I hereby certify that I desire to become an Ordinary Member of the British Mycological Society and that I will abide by the Rules if elected.

.....

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